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# Popular Science

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See page 38

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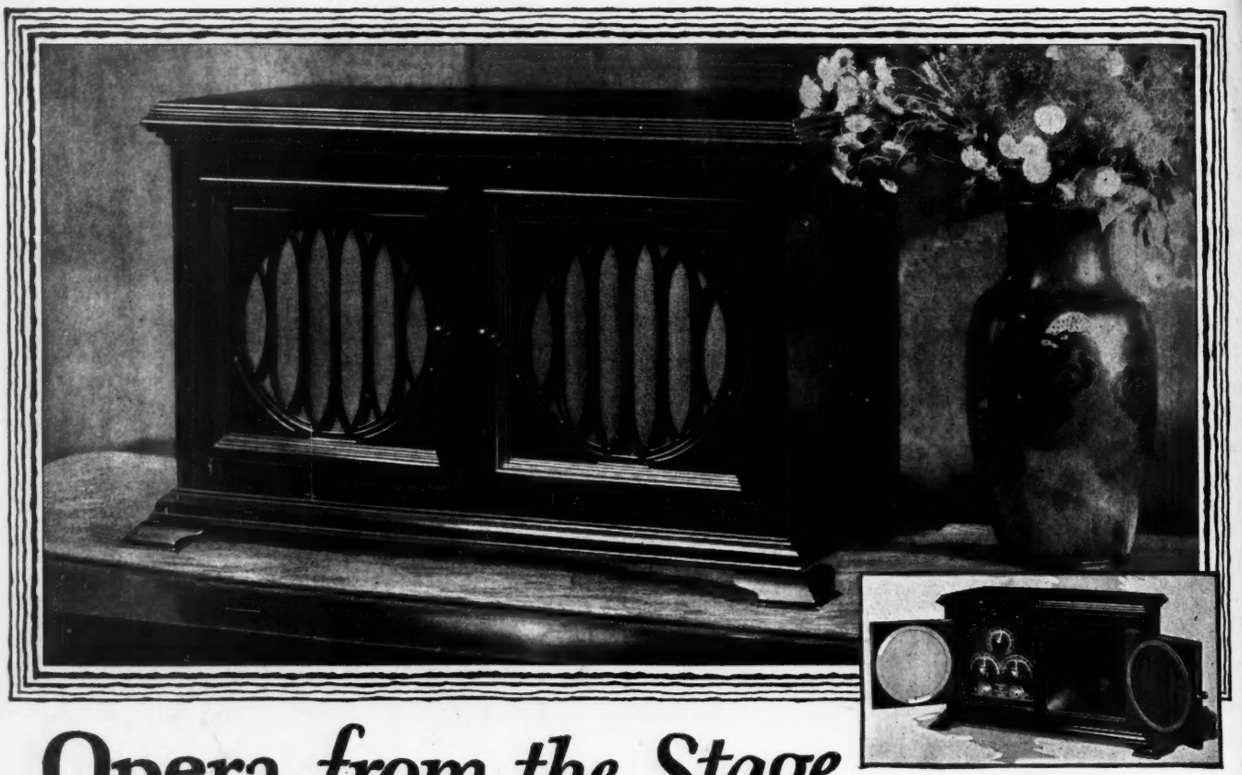

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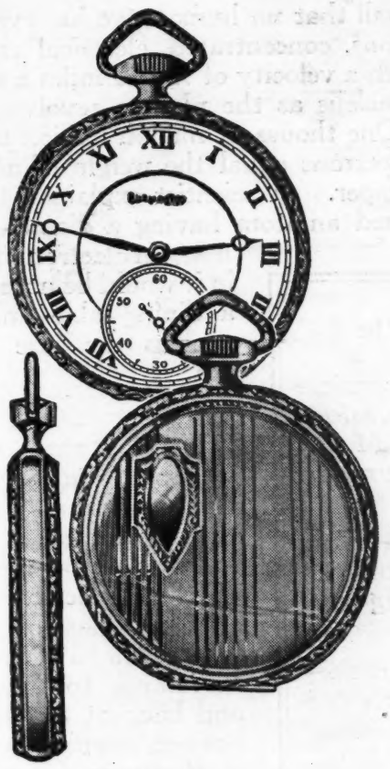

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# POPULAR SCIENCE MONTHLY

*Most Wonderfully Illustrated Magazine in the World*

*DECEMBER, 1923; Vol. 103, No. 6*
*25 cents a Copy; $2.50 a Year*

*Published in New York City at*
*225 West Thirty-ninth Street*


A YOUNG fellow in our town used to have an exaggerated opinion of his own importance. He talked a lot and said little. Now he thinks a lot and talks little. He has been reading and thinking of recent revelations of science in the world of the infinitely large and the infinitely small. Such thought is good to reduce the ego of mortals.

* *

CONSIDER our stellar system, the Milky Way. It consists of millions of stars, alongside of which our sun, a giant compared to the earth, is but a dwarf. Antares, the largest star yet measured, larger even than Betelgeuse, has a diameter of 400,000,000 miles. Our world, with its diameter of 8000 miles, compares with it about as does an anthill with the Woolworth Building.

* *

YET in the depths of space are many other systems, perhaps larger than ours. If by some chance the earth should collide with one of these tremendous celestial bodies, it would disappear as quickly as a snowflake in a blast furnace. Romance is there—the romance of the infinitely big. And there is mystery, too—the mystery of the unknown and the intangible.

* *

ROMANTIC also is the atom. Its wonders are invisibly small. Each atom is a miniature solar system, so small that no human eye has ever seen it. Electrons, concentrated electrical charges, revolve with a velocity of 93,000 miles a second about a nucleus as the planets revolve about our sun. One thousand million million million of these electrons equal the weight of a single cigarette paper. A scientist explained that if one imagined an atom having a diameter of a mile, an electron moving in it would be as large as a dining-table and the nucleus the size of a pea.

* *

TEAR the atom apart and you will find it veritably alive with a prodigious force. It has been pointed out that the electronic energy in a glass of water is sufficient to propel the *Leviathan* to Europe and back at top speed. Science, inseparable twin of Romance, is striving to harness this tremendous power. One day it will do the work of the world.

* *

ON THIS planet, where a thousand miles is a great distance and the head of a pin is small, it is difficult to comprehend the infinite. We are in something of the position of moths, attracted by an arc light, striving to understand electricity. But stories of these wonders serve to reduce the ego. They did that for the young man in our town. And they help men understand the promises of science for the future of the world.

## In Next Month's Issue

**The Story of the Mind**—*First article in an unusually helpful psychological series by James J. Walsh, M. D., Ph. D., famous American surgeon and psychologist.*

**Harnessing the River Jordan**—*How Science, in its restoration of the Holy Land, today is carrying out ancient Biblical prophecies.*

**Jack Binns on Radio**—*An understandable and usable article on the heterodyne receiver by the foremost writer on radio in America.*

**Your New Car**—*Mechanical improvements in the 1924 automobile. A practical article that will help you make your selection.*

***And 200 other fascinating articles and pictures***

***See Special Christmas Offer on page 88***


**POPULAR SCIENCE MONTHLY**

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H. J. Fisher, *President;* R. C. Wilson, *Vice-President*
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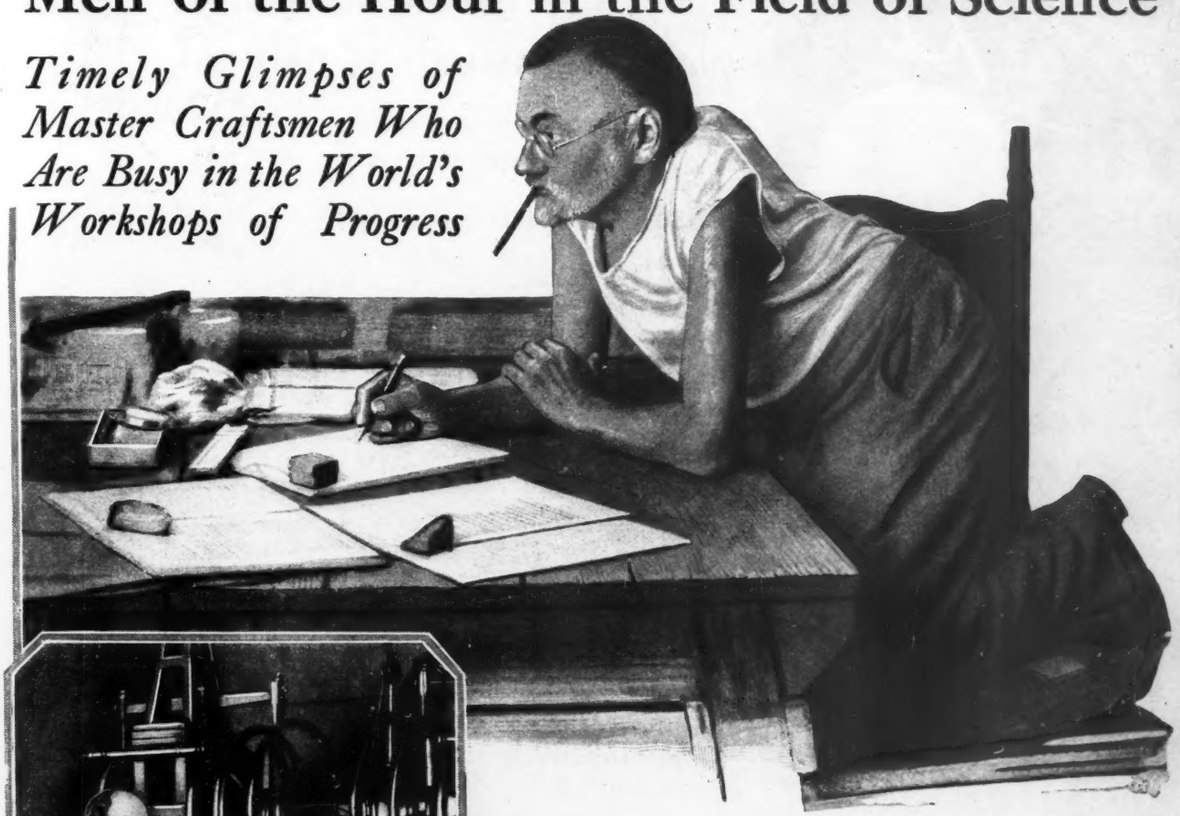
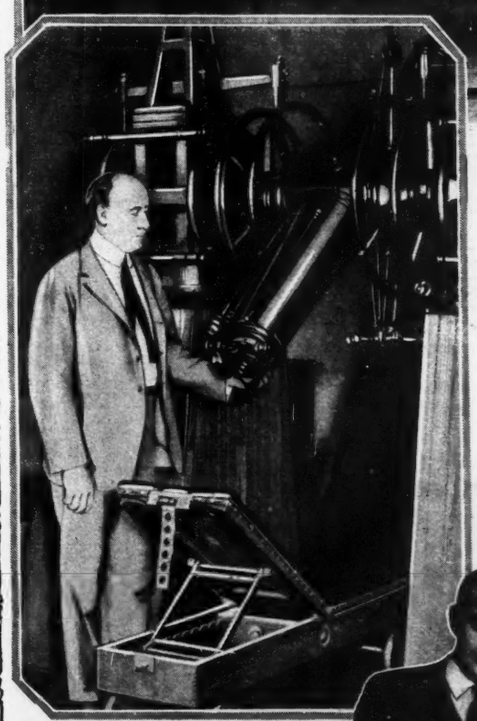
# Men of the Hour in the Field of Science

*Timely Glimpses of Master Craftsmen Who Are Busy in the World's Workshops of Progress*



DR. CHARLES P. STEINMETZ, world-famous electrical wizard. In a recent remarkable prophecy of the world in 2023, he declared that we are on the threshold of an age that will witness a greater flowering of man's ingenuity than the 100 years through which we have just passed. He predicted that the time is coming when there will be no long, back-breaking drudgery and when people will work not more than four hours a day.



PROF. J. C. HAMMOND, astronomer of the Naval Observatory, Washington, D. C., working at a six-inch transit circle with which he tells the accuracy of time. He claims to have proved that clocks do not run faster at night than in the daytime—a question much discussed by astronomers.

F. J. TURQUAND, London mining engineer (seated below), has perfected a delicate instrument to test milk by making impurities audible over the telephone. He is shown demonstrating his apparatus which, he says, is valuable also in detecting deadly choke damp in coal mines, thus preventing disastrous explosions.

DR. RALPH H. McKEE, Professor of Chemical Engineering and Chemistry at Columbia University. He has developed a new method of manufacturing "intarvin," an artificial fat, the new remedy for diabetes discovered by Dr. M. Kahn.

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POPULAR SCIENCE MONTHLY
SUMNER N. BLOSSOM, Editor
December, 1923

# Will the ZR-1 Discover a Polar Paradise?

The giant new navy dirigible ZR-1 in test flight. If she makes the voyage across the North Pole next summer, it will prove, according to Vilhjalmur Stefansson, famous arctic explorer, "one of the turning points in history"

HERE is one of the most astounding stories of scientific possibility ever published.

Commander Green's exclusive article has all the pungency of romantic fiction; at the same time it is founded on the scientific observations of a veteran arctic explorer, and corroborated by fascinating legends of the Eskimos.

Not since the days of Columbus has any venture held such power of gripping the world's imagination as the proposed voyage of the ZR-1.

In the issue of POPULAR SCIENCE MONTHLY for November, 1920, the prophecy was made that "a huge dirigible of the Zeppelin type will enable the explorer of the future to study the geography of the poles in a really scientific way." Now this promise is to be fulfilled in the projected transpolar flight of the new navy dirigible next summer. What will be the outcome?

Commander Green's entrancing picture of a balmy polar paradise represents, he says, simply a tremendous possibility of arctic aeronautic exploration. In his article he sets forth the facts as he has gathered them. Whether you agree with his theory or not, you will find it absorbingly fascinating.

## By Lieutenant-Commander Fitzhugh Green, U. S. N.

IN THE proposed transpolar flight of the huge new navy dirigible, the ZR-1 (the *Shenandoah*), next summer, lies the most thrilling possibility that ever faced a single body of explorers:

*In the center of the unknown area of the Polar Sea may be discovered a vast continent heated by subterranean fires, and inhabited by the descendants of the lost Norwegian colony of Greenland!*

So wild is the idea as to tax the most gullible imagination. Yet it is vividly encouraged and supported not only by history and tradition, but by the searching test of scientific analysis.

Witness the astounding facts:

Within boundaries of the Polar Sea spreads the greatest unexplored area on the surface of the globe: 1,000,000 square miles on which no human eye has gazed! Look at the map on page 31. Most of this enormous wilderness lies on the Alaskan side of the Pole. On the European side lies Iceland at a point corresponding roughly to the center of the unknown area opposite it across the top of the world. This fact is significant.

Experts are in nearly unanimous agreement that a new arctic land will be found by the ZR-1. Doctor Harris, the tidal expert in Washington, D. C., long ago declared that the data he had worked out from polar ocean currents all convinced him that the existence of a large land-mass near the North Pole is indisputable.

Add to this the array of evidence geologists adduce on the basis of terrific volcanic activity along a well-defined line leading up the North Pacific, through the Japanese archipelago and the fiery Aleutians, and onward toward the Pole. This seismic axis plotted on the globe nearly bisects the unknown area of the Polar Ocean. Further, were this line swung through 180 degrees, it would touch Iceland, one of the most fiercely volcanic spots on earth. Another significant fact.

Will the ancestors of the Lost Colony of Vikings who mysteriously vanished from Greenland centuries ago be found inhabiting a steam-heated polar continent? Eskimo tradition paints in vivid terms the White Men swarming suddenly northward to a wonderland the natives long had known—a land of endless summer, rich in vegetation and game

Still more: Not many years ago, in a particularly open season, the American whaler, Captain Keenan, reported he saw land northeast of Point Barrow. Peary, from Cape Thomas Hubbard, sighted distant peaks northwest. Such evidence is incontrovertible. The new continent seems already within our grasp!

So much for the land-mass. Now for its probable inhabitants.

Eric the Red discovered Greenland in 985 A.D. He brought back glowing tales of grassy fiords, long sunlit days, game-infested hills, ice-pans groaning under their burden of fat seals, bays teeming with fish.

## *Vikings Prosper*

Colonization began at once. And so true did Eric's bright tale prove that the Vikings greatly prospered. In the archives at Bergen may be seen today the receipts for their princely contributions in ivory and oil to the ill-fated Crusades.

The last ship known to have returned to Norway from her arctic colonies arrived in the year 1410. We read that it brought a rich cargo; that its report was of happy, thriving Norsemen back north; of health and growing independence despite their rigorous environment.

Then, as in 1914, Europe became a shambles. Plague and war swept civilization. Pestilential disease ran a ghastly race with a horde of human murderers. Greenland fell out of the minds of man. Even the sea route north was forgotten. . . .

## *Lost Colony a World Riddle*

Dark ages passed. Slowly Nature bred again in men the will to search her world for knowledge and for wealth. Greenland was rediscovered. Hans Egede established the first modern settlement there in 1721. But the grim report he made was tragic beyond belief:

*The Norwegian colony, 10,000 people—perhaps 100,000—had, to a man, mysteriously disappeared!*

"The greatest riddle in the history of the world," it has been called—the baffling mystery of the lost Norse colony.

Where did they go?

Where didn't they go is a question more easily answered. Not to sea in ships, for they had but one or two; and Greenland, lying above the tree-line, gave them no timber for building more. Not slain by Eskimos, for Eskimos are the most peace-loving people in the world, knowing nothing of the art of war. Not, like Europe, swept by some dread germ of awful virulence, for germs don't thrive in polar regions.

What then?

Examine the Eskimo tradition: It paints in vivid terms the White Men swarming suddenly north to a wonderland the natives long had known. Because of evil spirits, no Eskimo had ever dared this trail.

"The land is warm; is clothed in summer verdure the year around; is populated by fat caribou and musk-ox. It lies," they say, even to this day, "in the direction of the coastal trail-route north."

This route is that taken by our American expeditions. Peary, Kane, and Hayes all used it. It always has been the easiest route as well as the most productive of natural food in seal and walrus. For our explorers it has been a hard trail. But for the Norwegian colonists whose forebears had spent 10 generations north of the arctic circle it must have been less difficult to travel than were the western plains for our American pioneers.

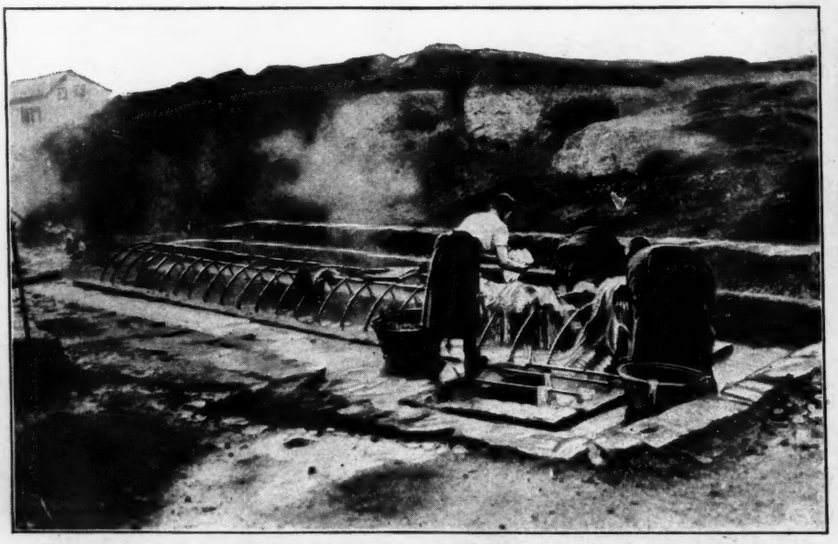
## *Lured Northward*

Picture the terrible situation in which the deserted Norsemen in Greenland found themselves: No outlet for their trade. No source of supply for the little but indispensable luxuries of life. No access to friends and families back home.

A generation—two, perhaps—of heartbreak and of longing; unhappiness goading the younger men to travel northward. Perhaps a route to southern lands lay that way.

Suddenly like a bombshell breaks upon the weary colony the wonderful news: "We've found a polar paradise! Sunshine! Game! Grass! One moon's easy journey north! A short lap on the sea ice! *Come!*"

What had they to wait for? A century had passed since the last ship sailed. The last man who had seen a real Norwegian had died. The homeland was but a myth. So they "packed and, singing songs, departed," the native legend puts it,



Washday in Iceland, where hot springs and boiling mud abound. An engineering scheme for steamheating the whole island by harnessing its steaming geysers has been projected recently. It is no idle dream, says Commander Green, to believe that Iceland has a geographical mate on the opposite side of the Pole—a polar continent of mild climate and luxuriant vegetation, warmed the year round by hot springs and geysers.

## An Adventurer in the Icy Desert

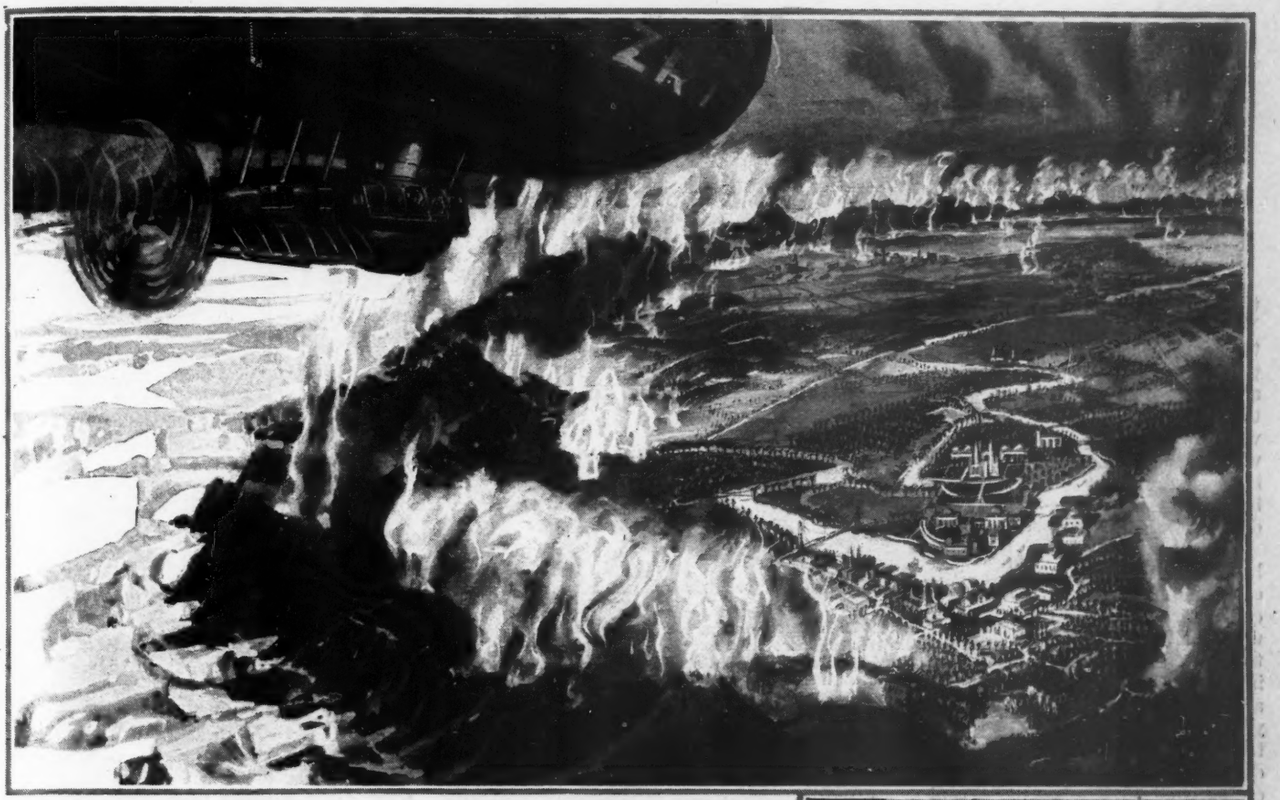
"WITH my own eyes I have seen in Greenland the ruined stone houses of the lost Norwegian colony," writes Commander Green. "With Donald B. MacMillan I have tried to reach the polar continent, believed to lie in the Polar Sea north of Canada."

As an arctic explorer of wide experience, Commander Green—now aid to Admiral Williams, President of the Naval War College at Newport, R. I.—has made an exhaustive study of the fascinating possibilities of discovery of which he writes. Following his graduation from the United States Naval Academy at Annapolis, he joined the Crocker Land Arctic Expedition as engineer and physicist in 1913. He spent 3½ years in the polar regions.

In the spring of 1914, with MacMillan and two Eskimos, he sledged more than 1000 miles up across Ellesmere Land and out into the Polar Sea in search of land that tidal experts insist must lie in this million square miles of unexplored area. They also explored an unknown portion of Axel Heiberg's Land.

The next year, after their relief ship had become imprisoned in the ice of Smith Sound, Commander Green, with two other members of the expedition, sledged south, passing down the uninhabited portion of the Greenland coast and reaching the Danish colonies five months later, in the spring of 1916. Reaching New York by way of Copenhagen in the autumn, he joined the Atlantic Fleet on regular duty. The following spring he became Flag Lieutenant to Admiral Rogers in command of the division of United States battleships attached to the British Grand Fleet in European waters.

Lieut.-Com. Fitzhugh Green, U. S. N., from a photograph taken in the Arctic



Our artist's conception of the discovery of a possible "polar paradise" by the ZR-1, based on Commander Green's imaginative article. This land, the explorer believes, may be about the size of the state of Pennsylvania, and may be encircled by a lofty, volcanic range of mountains buried in eternal ice and snow. Behind a veil of fog may lie a fertile plateau where heat from hot springs, geysers, and boiling pools defies the cold. The illustration shows the possible habitations of the modern descendants of a vanished race of Norsemen

This map shows the proposed transpolar air route of the ZR-1 from Alaska to Norway. Cutting the distance to European and Asiatic capitals from 11,000 to 5000 miles, this route would pass across what many geologists believe to be an unexplored polar land on the opposite side of the Pole from Iceland. The curving dotted line indicates the possible route which the "lost Norsemen" may have followed to this imagined arctic wonderland

"suddenly to the northward." They never returned. This fact is not at all surprising if what we think is true—that they found a land of milk and honey in the very center of the polar pack. And it is perfectly logical to suppose that their descendants will be found up there next summer by the dirigible ZR-1, in dramatic isolation.

Go back to the scientific data on which we base this amazing assumption. Iceland's collection of volcanoes is unsurpassed. She has 107 major craters within her tiny limits, and thousands of minor ones. Iceland's climate is temperate despite its arctic situation. The peace, the health, and the prosperity of Iceland's inhabitants were sustained by its natural warmth during the 200 years of isolation from Europe that it suffered at the same time and for the same reasons that the Greenlandic Norsemen were deserted.

Moreover, Iceland's lava flows are by no means always from conventional craters. The greatest of them have come quietly from fissures in the level land. We may deduce that subterranean fires smolder near the surface. It is not uncommon for the inhabitants to be forewarned of eruption by sudden melting of the snow and ice.

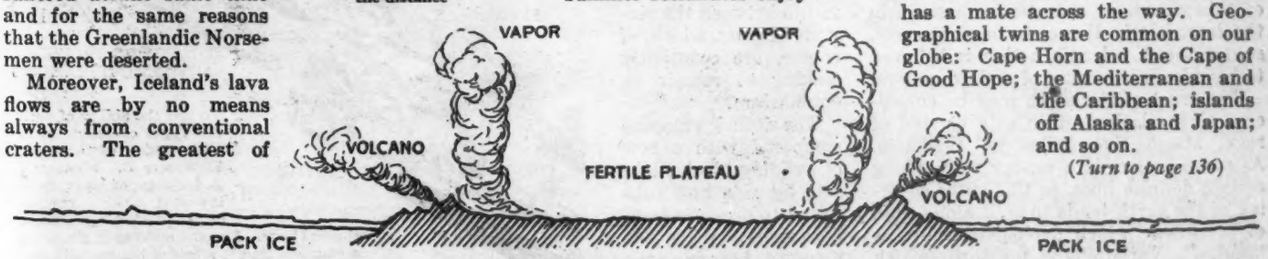
How the barrier mountain range of the new land may appear from the distance

Hot springs and boiling mud are found in every part of Iceland. There has been projected an engineering scheme for heating the whole island by harnessing its steaming geysers.

In this connection it is interesting to compare the mean annual temperature of Iceland—34° F.—with that of Greenland at the same latitude—*minus* 15° F. During the summer Icelanders enjoy a period quite comparable to that of our own New England States. Averages run up to 60° F.

It is no idle dream to claim that Iceland has a mate across the way. Geographical twins are common on our globe: Cape Horn and the Cape of Good Hope; the Mediterranean and the Caribbean; islands off Alaska and Japan; and so on.

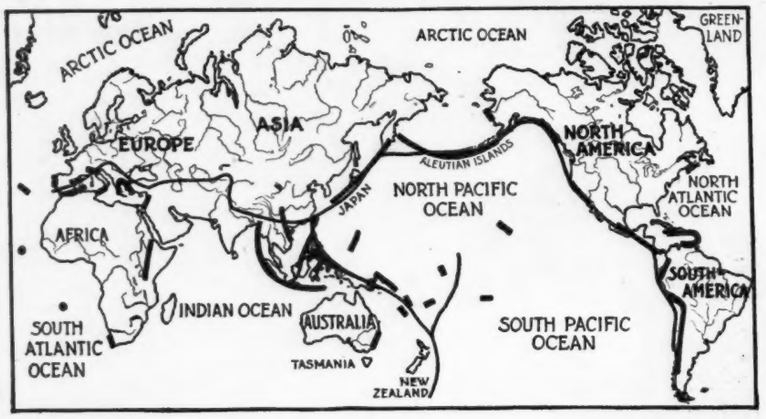
(*Turn to page 136*)




Commander Green's own idealistic drawing, showing a cross section of the imagined arctic continent—an undulating, fertile plateau, steam-heated by hot springs, geysers, and boiling pools and rimmed by a volcanic range of mountains. Behind this barrier rises a veil of vapor

# Can Man Rob Earthquakes of Their Terror?

By R. E. Martin




The black lines mark earthquake zones that girdle the world, forming narrow belts of potential disaster. Note that the United States, except for the Pacific Coast, apparently is free from danger of quakes. The most unsettled part of the earth's surface is the western shore of the Pacific Ocean. This map was prepared by Prof. F. Omori, head of the Imperial Earthquake Investigation Committee of Japan, who nearly two years ago made the forecast that severe shocks would be experienced within six years

WHILE Japan clears the wreckage of the cities of Tokio and Yokohama, leveled by the recent earthquake, the forces of science are being marshalled to find a way to prevent repetition anywhere on earth of what is now known to have been the most terrible disaster in history.

Not that science hopes to prevent other earthquakes. These cataclysms of nature undoubtedly are due to structural changes in the earth itself, and are consequently beyond the power of man to control. But science does expect in time to remove the chance of any such terrible loss of life and property as marked the Japanese catastrophe.

Means of forecasting earthquakes so that the inhabitants of a threatened area may flee in safety before the quake arrives, and the construction of earthquake-proof buildings—these are the goals toward which science is working. In the opinion of leading scientists the day is not far distant when people may live in larger security in places like Japan where earthquakes are of frequent occurrence.

## *4000 Earthquakes a Year*

The tremendous importance of this task in which some progress already has been made is evident when we consider that 160,000 earthquakes actually have been catalogued and that about 4000 earthquakes are felt each year in different parts of the world.

Probably the most important work that has been done in the observation of the causes and nature of earthquakes has been accomplished since the beginning of the twentieth century. Previously all earthquakes were generally regarded as being of volcanic origin. Scientists now believe that most earthquakes are caused by wrinkling and slipping of part of the earth's crust, caused by strain resulting from shrinkage of the more plastic interior of the earth, contortion of the earth's strata, or changes in pressure in the crust itself. However, in some cases, subterranean volcanic action is believed to have been the cause of certain quakes.

The crust of the earth may be considered as a relatively thin skin or rind of rock, about five miles in thickness. As stone broken in a quarry splits along certain definite lines, so this outer covering of the earth tends to split along lines of weakness which geologists know as "faults." Variations in pressure—which may be caused by the weight of mountains or of the water in the ocean—cause movements or dislodgements between the sections of crust, which, of course, are constantly seeking to remain in equilibrium.

The situation may be compared with a row of building blocks, laid side by side and subjected to pressure from both ends. When the pressure becomes too great to be resisted by the friction between the blocks, something will give. They will buckle, and the buckling will correspond in a way to the movement of the earth's crust that causes an earthquake.

The most unsettled part of the earth's surface is the western shore of the Pacific Ocean. Here the crust is being thrust upward, giving rise to steep slopes. It was such a buckling of the earth's crust along the cracks believed to exist in the bottom of the Tuscarora Deep, off the coast of Japan, that caused the recent disaster, according to theories so far advanced. The proximity of the Japanese coast to this great trough-like "deep," which goes down more than five miles, and the numerous earthquakes experienced by Japan, lend weight to the theory that pressure exerted by this tremendous volume of water is the cause of such disturbances.

Earthquakes under the sea are called seaquakes. So tremendous are the waves that they can travel at a rate of four or five hundred miles an hour, and still be detected after a journey of more than 10,000 miles.

Earthquakes are known to have occurred in the eastern part of the

To test the ability of various types of buildings to withstand earthquakes, Professors B. Mano and A. Inokuty, of Japan, have invented the engine-driven shaking table shown above. A model building is placed on a platform that is vibrated horizontally and vertically by means of eccentrics and levers to duplicate typical earthquake movements

How the recent earthquake in Japan split and crumbled the Tokio-Yokohama highway near Kawasaki, opening great gaps

A scene of appalling devastation along the waterfront of Yokohama, following the terrific earthquake and tidal wave of September. Scientists believe now that most earthquakes are caused by the fracture and slipping of the earth's crust as the earth contracts (see diagram at the left). Some quakes, however, are believed to be the result of subterranean volcanic action, as shown at the right

United States at various times, but science scouts the notion of any quake of a devastating sort ever visiting any but the western coast of America.

Following the Japanese shock, Dr. Bailey Willis, emeritus professor of geology at Stanford University, asserted unequivocally that man and not nature is to blame for the disastrous consequences of earthquakes in localities like Japan, Chile, and California, which are known to be in the earthquake zone. His statement was based on observations in Chile, where he had been investigating causes of earthquakes for the Carnegie Institution of Washington, D. C. He pointed out that it is not the earthquakes themselves—the actual ground tremors—that cause the frightful loss of life, but the events that follow the quakes—the falling of masonry, the fires, the floods from reservoirs and similar things.

"To construct a house that will withstand an earthquake is not difficult if you can command the right materials and good carpenters," says Doctor Willis. "A point that has not been recognized generally by architects or engineers is that it is the earth that moves, while the house tries to stand still. If you could put a ball bearing between your house and its foundations, it would be safe in time of earthquake. This idea is embodied in every instrument for recording earthquakes and was applied many years ago by Sir John Milne to the construction of a lighthouse in Japan. I believe it can be introduced successfully in some combination of bearings, springs, or shock absorbers.

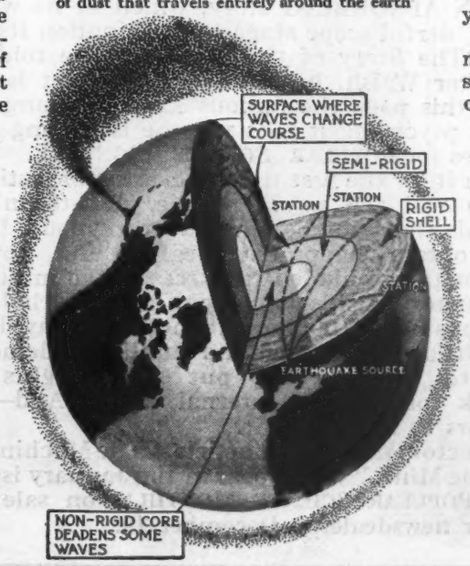
"For the ordinary house a broad ditch packed with cobblestones on which there rests a well braced frame of heavy beams would not be a bad substitute. It would allow the ground to slide around under the house, which could be jacked back into position with reference to such unstable things as trees, garden walks, and roads at your convenience."

Doctor Willis adds that the displacement within the earth that results in rock slips that science now regards as the cause of earthquakes is developing below the surface for months before the quake occurs. This displacement usually does not actually reach the surface, but produces vibrations or waves that can be recorded by special instruments as a means of obtaining forewarning of the coming quake. The vibrations travel great distances at high velocity before they die out.

"The instruments will have to be set up in many places," said Doctor Willis, "and records kept for years before the science of predicting earthquakes is set on a firm basis. I think it is not at all unlikely that in the future earthquakes can be predicted much as the weather is predicted now. Warnings can be sent to threatened districts and measures taken by the populations to save themselves."

### WHAT'S INSIDE THE EARTH

Recent study of earthquake waves has led to new scientific discoveries indicating that the earth's interior may be divided into three definite zones—a rigid, elastic outer shell; a semirigid metallic intermediate zone, and central non-rigid core. This theory is deduced from seismographic records showing that the course of earthquake waves through the earth is curved toward the surface; therefore that the earth is denser and less rigid at its center. The three zones of the earth's interior are indicated in the illustration, which shows how volcanic outbursts throw up millions of tons of dust that travels entirely around the earth



# The Story of the Mind

## *The Most Fascinating Psychological Series Ever Published*

**By James J. Walsh, M.D., Ph.D.**

AS A physician I have always been inclined to think that whenever anybody dies of typhoid fever, somebody ought to be hanged, because there has been criminal negligence somewhere; some one has permitted contaminating materials from a typhoid patient to get into the food or drink of a healthy person.

### *Banish Fear and Ignorance*

It is the same sort of crime for human beings to allow their efforts to be palsied by dread of failure. It is criminal to allow the initiative to be hampered by lack of confidence; to restrict the display of energies just because of a lack of self understanding. This can be prevented by realizing that what one individual can do, others can do, and that the only reason for failure is lack of knowledge of personal powers and neglect to use them.

"But how may I acquire this knowledge?" you may ask. The answer is simple—through psychology.

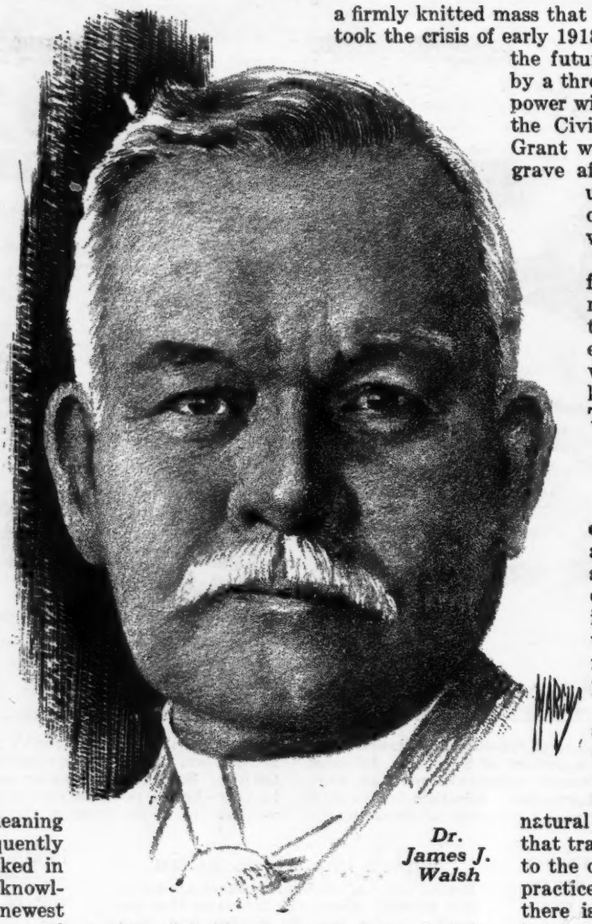
And what is psychology? *Psyche* is a Greek word, meaning "mind," and *logia* is another, meaning "knowledge." Psychology—frequently misunderstood and generally cloaked in long, mysterious words—is simply knowledge of the mind. One of our newest sciences, it has a more intimate personal appeal and offers a wider application in practical usefulness to you and to me than almost any other science, old or new.

It brings us knowledge of our own minds—the way in which they work, their powers, capabilities, possibilities, and shortcomings. And, what is more important, it shows us how to make practical use of this knowledge—how to find greater happiness, health, and power through our hidden mental resources.

### *Why Men Fail*

A great many men fail in life, not because they lack talent, but because they fail to employ their minds properly; because they do not realize or use the qualities they possess. When critical emergencies arise, men often prove to have hidden genius for leadership and unsuspected power of accomplishment.

Who ever heard of Marshal Foch before the war? Only a few professors of military science who knew him as a writer of textbooks on tactics and strategy. That was all. But he proved to be one of the greatest men of history, capable of lending something of his own soul to millions of men and of welding them into a firmly knitted mass that proved irresistible in action. It took the crisis of early 1918, when the fate of nations and the future of civilization seemed to hang by a thread, to bring forth all the latent power within him. If it had not been for the Civil War, our own great General Grant would have sunk into a nameless grave after a commonplace and almost useless life. As it was, he proved one of the greatest leaders of the world's history.



*Dr. James J. Walsh*

War afforded the opportunity for Foch and Grant, but it did not make them. These men knew themselves. They knew the energy and power that was hidden within themselves. And they knew how to use these powers. Therein lay their greatness.

### *Every Task a Test*

We can't all lead armies, but every task in our daily lives affords an opportunity to do something a little better than we ever have done it before, or to do it in a new way. We succeed or we fail according to whether or not we know our own mental powers and how to use them.

Of 10 men who crouch at the starting line in a foot race, only one can win, though they all have had equal training and practice in running. The winner possesses natural advantages in speed and stamina that training and practice will not supply to the others. But through training and practice, through developing the best there is in them, all 10 probably have learned to run faster than any of those who watch the race from the grandstand.

So it is with psychology. Learning to draw on the hidden powers of your mind and to put them to use may not enable you always to outstrip those with superior mental gifts. But undoubtedly it will give you a tremendous advantage over those who merely sit by idly, unconscious of the wellspring of power that is within themselves.

### *Psychology the Key*

The aim, then, of practical psychology, or the knowledge of yourself as applied to yourself, is to enable you to bring out and use what is best in you. An understanding of it may mean the difference between success or failure in your life.

Psychology is the key that will open the door to the wondrous storehouse of hidden powers contained in your mind, and in the series of articles that I am about to begin in POPULAR SCIENCE MONTHLY, I shall endeavor to put that key in your hands.

**AN ABSORBING story, which in its wonderful scope staggers imagination itself, is "The Story of the Mind," to be told by Doctor Walsh, beginning in the next issue. On this page the famous American surgeon and psychologist tells why he is writing the series for POPULAR SCIENCE MONTHLY.**

**In it for the first time a scientist of distinction will tell us in simple, non-technical words that may be grasped by anybody, how to obtain happiness, health, and power through the hidden resources of the mind.**

**Doctor Walsh's psychology is the psychology of business, the home, and every-day life. With fascinating fact and parallel he demonstrates that we may put our thoughts to work for definite external ends. And—he shows us how to do it.**

**Doctor Walsh's first article, "The Machinery of the Mind," will appear in the January issue of POPULAR SCIENCE MONTHLY, on sale at your newsdealer's, December 10.**

# The 10 Greatest Inventors

## *And What They Have Given to Modern Civilization*

**By John S. Seymour,**

*Formerly United States Commissioner of Patents*

I AM to select the 10 greatest inventors of modern times, and in doing so my guide and chart necessarily must be the history of past achievements as reflected in present-day civilization.

When mankind began on earth, hundreds of thousands of years ago, there was no knowledge of fire or of pottery, of the bow and arrow, of domestic animals, of iron or of writing. There was no articulate speech. In the progress through savagery and barbarism, this knowledge was acquired little by little, and with it came the beginnings of civilization.

From the time of the revolutionary discovery of fire the progress of invention was steady but unspectacular until 400 years ago, when a series of discoveries gave a tremendous impulse to civilization. These discoveries were gunpowder, the mariner's compass, paper, and the printing press, the Copernicus demonstration that the sun, and not the earth, was the center of the solar system, and the discovery of America.

### *Pathfinders of Modern Progress*

Then began the era of modern progress. From this era I have selected the 10 inventors whom I consider the greatest, basing my judgment on their work—its utility, originality, and its permanent value in meeting the needs of mankind. These 10 greatest, all of whom have lived within the last 150 years, are:

| | |
|---|---|
| Eli Whitney | Elias Howe |
| Charles Goodyear | Sir Henry Bessemer |
| Samuel F. B. Morse | Thomas A. Edison |
| Alexander Graham Bell | Nikola Tesla |
| Cyrus Hall McCormick | Wilbur Wright |

Here we have the creators of the cotton gin, the vulcanizing rubber process, the telegraph, the telephone, the reaper, the sewing machine, the quantity production of steel, the incandescent light, the alternating current, and aviation; inventions great in themselves and each of them stepping stones to greater benefits to men.

WHITNEY

GOODYEAR

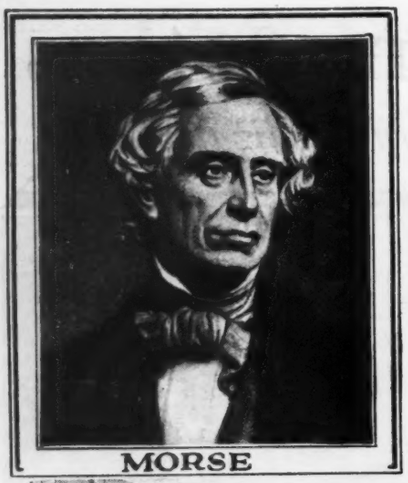
Eli Whitney's cotton gin dates back to 1793, 50 years before the telegraph of Morse, the sewing machine of Howe, the vulcanization of rubber by Goodyear and the reaper of McCormick. Among the 10 immortals of modern invention Whitney was the pioneer, not only because he invented the cotton gin, but because he led the way in a development from which most great manufacturing enterprises of today draw their life blood—the standardization of parts. Firearms were the principal mechanical contrivances of Whitney's day. They were made almost entirely by hand, and no two corresponding parts were exactly alike. Whitney was the first to realize that by making duplicate parts interchangeable for repairs, an appalling waste in material and labor would be eliminated. In achieving this end, he paved the way for the quantity production of watches, motor cars, and thousands of mechanical articles in use today.

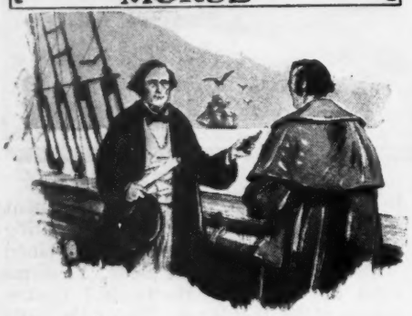
Whitney's invention of the cotton gin was original and basic and useful. The cotton that we use today in myriad forms and fabrics, would not be ours in the huge quantities we need and at prices we can afford to pay had not Whitney's genius prepared and lighted the way.

### *Father of the Rubber Industry*

To Charles Goodyear we owe our multifarious use of rubber—waterproof shoes and clothing, fire hose, combs, insulation for electric wires, rubber tires, and even golf balls. Prior to Goodyear, the treatment of rubber was primitive, faulty, and unsatisfactory. In hot weather the rubber became too soft. In cold weather it was too hard. Daniel Webster, describing his experience with a rubber cloak and hat, made prior to Goodyear's discoveries, said:

"I put the cloak outdoors one cold day, and it stood alone. This interested me and I tried placing the hat on the top of the coat. The effect was strikingly lifelike and passers-by, seeing the effigy on the outside, thought it was myself


MORSE



and hailed me in a neighborly fashion."

Chance played a part in Goodyear's success. He accidentally placed a piece of rubber mixed with sulphur on the kitchen stove. Instead of melting in contact with the hot iron, the mixture became hard. Subjecting the hardened specimen to further heat altered it not a bit, nor did it lose its flexibility when left outside the house in the winter air until morning. The problem of vulcanizing rubber was solved and Charles Goodyear earned his place among the great pathfinders of human progress.

A chance conversation played its part in furnishing the world with the electric telegraph, uniting the ends of the earth, pulling down the barrier of time and bridging a thousand gulfs.

### *How Morse Conceived Telegraph*

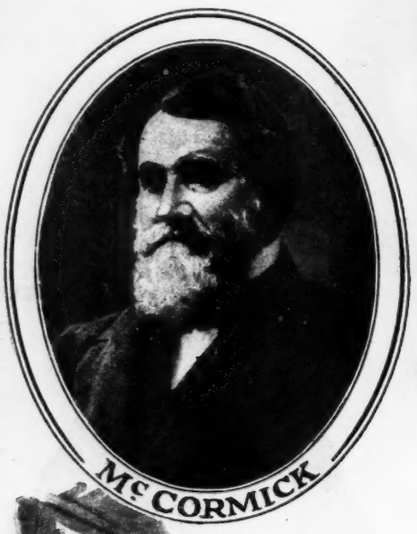
At the age of 40, Samuel Finley Breese Morse was a successful artist. Returning from Europe in 1832, after a trip abroad to widen his knowledge of art, he heard a fellow passenger describing a recent electrical experiment. An electric current had been passed through a chain and bright flashes of light were visible among the links. To Morse, though untrained in science, occurred instantly the thought, "if electricity can be made visible it can be employed to carry messages."

Before the ship reached New York, Morse had evolved the general scheme of the Morse Code, and had even named the invention he intended to make some day, the "telegraph." As he left the ship he said to the captain, "If you hear of the 'telegraph' some day as the wonder of the world, remember that the discovery was made on your ship."

In January, 1838, his first message was clicked off over three miles of wire stretched about the room in which he worked with his associate, Alfred Vail. On May 1, 1844, when the Baltimore and Washington line had been completed, Morse signalled the nomination of Clay for President to the national capital, where the news was received with amazement.

Morse lived to the age of 81, and saw the earth engirdled by wires. No man holds a more secure place among the great.

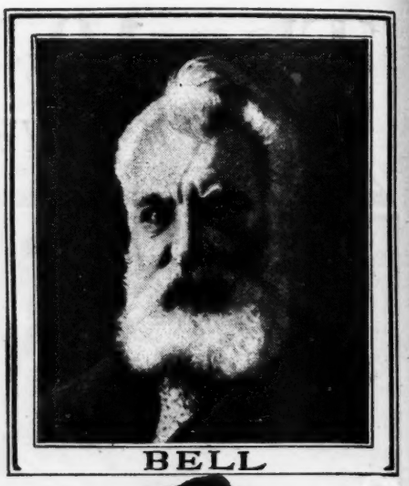
Alexander Graham Bell is the real father of the telephone, while Reis, Edison, Gray, Dolbear, Berliner, Hughes, Blake, and others are supporting con-

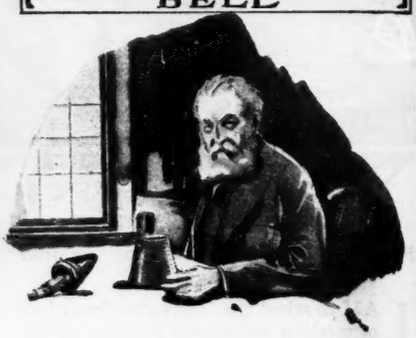

Mc CORMICK

tributors. Others had the interrupted current; Bell had the continuous undulating current.

It is incorrect to say that the telephone transmits speech. It transmits only a small, silent, continuous variable electric current and thereby at the receiving end

HOWE


BELL



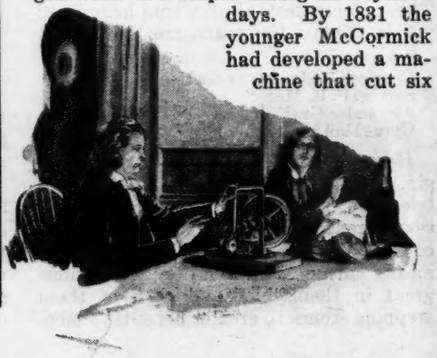
speech is *reproduced* by the vibrations of a diaphragm. In his application for his fundamental patent in 1876, Bell said nothing about transmitting speech nor reproducing speech at a distant point; his invention up to then was concerned with the reproduction of pitch and music.

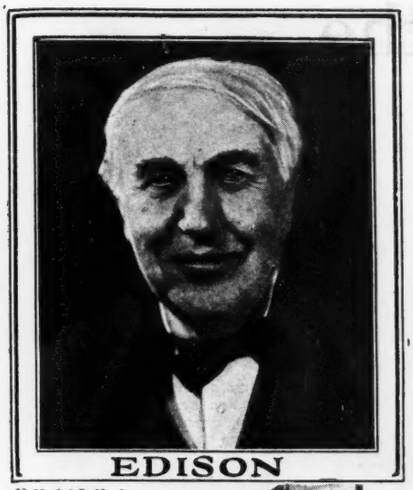
Then some one accidentally spoke into the transmitter and to the astonishment of all, the words were reproduced at the receiving station. The telephone was complete before it was known that it could reproduce speech. Once regarded as a toy, it has experienced an amazing growth, more intensive in America than anywhere else. Today there are 14,000,000 telephones in the United States averaging 35,000,000 messages a day.

### *McCormick's Reaper Was Sneered At*

Through the reaper of Cyrus Hall McCormick the world gets its bread. Yet when this machine was first exhibited at the World's Fair in London, the public smiled dubiously and the London *Times* ridiculed the contrivance as "a cross between a circus chariot, a wheelbarrow, and a flying machine."

McCormick's father had tried to develop a reaping machine and the son began work on a reaper during his boyhood days. By 1831 the younger McCormick had developed a machine that cut six





EDISON

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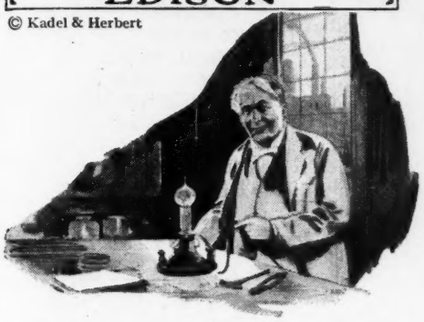


acres of oats in one afternoon—equivalent to the work of six men with the scythe.

Forty-six other inventors before McCormick had attempted to develop a mechanical harvester and had failed. Cyrus Hall McCormick levelled the obstacles and made a device that was revolutionary and epochal. The descendants of his first reaper still harvest the grain crops of the world.

## *Howe and His Sewing Machine*

Circumstances were a powerful factor in the invention of the sewing machine, the greatest of all labor savers for the home. Elias Howe was lame and sickly. His wife contributed to the family income by sewing. Unable, because of his health, to relieve her from her irksome labor, Howe sought to lighten it by devising a machine.

To imitate the motions with which a woman sewed he produced a needle pointed at both ends with an eye in the middle, which worked up and down. But after repeated failures Howe saw that the machine should have characteristic motions of its own. In applying this thought, Howe made use of the shuttle with which he had become familiar in working with the looms of the mills. At last he evolved a lockstitch from the shuttle and gave the world the first successful sewing machine in April, 1845.

The number of useful articles made cheap and available by the sewing machine runs into the thousands. Few inventors of all time have performed a more useful work than Elias Howe.

The machinery of today that produces the food we eat, the clothes we wear, the cars we ride in, the offices and factories we work in, the rails on which we travel, is linked with the epoch-making material in the world's history—steel.

Steel in small quantity was the possession of mankind for many centuries. But

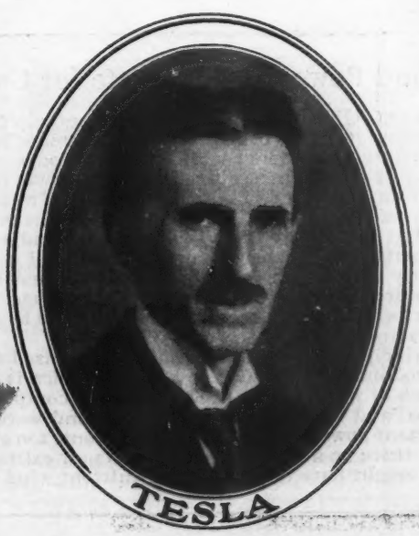
BESSEMER

quantity steel marked the beginning of a new era—the modern age of steel. This age was born of a boy's fondness for casting mixtures from type metal. That boy was Henry Bessemer of England. Through his persistent genius he became the inventor of the Bessemer process of converting pig iron into steel and by that invention takes his place among the great.

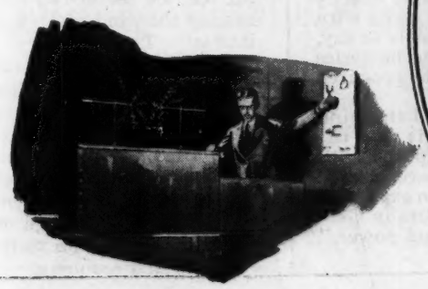
This idea of converting iron into steel originated in Bessemer's efforts for devising heavier projectiles for cannon. The remark of an army officer that heavier projectiles would be of little value without stronger steel for the guns, stirred Bessemer on to experiments with molten iron. Soon he discovered that when a mass of molten iron came into contact with air under specific conditions, the carbon content, and therefore the hardness of the metal, could be controlled.

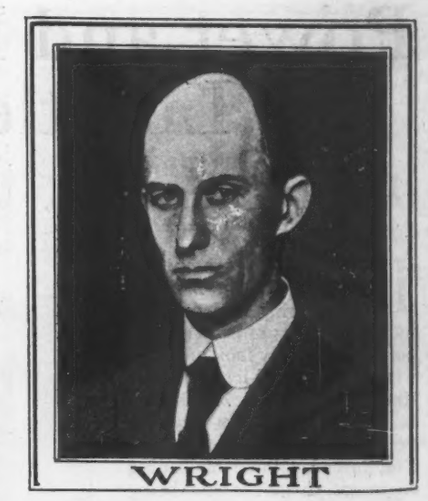
It was only a short step to the completion of the process of converting pig iron into steel by forcing air into the molten metal, a process that brought steel into every-day use, in quantity, and created the modern industrial giant with its railroads, bridges, ships, automobiles, and skyscrapers.

Paralleling the age of steel is the new age of electricity, which, though still in its infancy, already is remaking the world, linking states and nations with networks of quick communication, lighting homes, supplying conveniences and labor-saving instruments and carrying the power of rivers and streams to turn the wheels of industry and to run our trains.



TESLA





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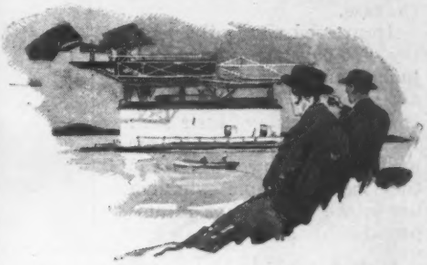


## *Cheaper Power from Waterfalls*

Until recent years the factory had to be built alongside the waterfall. This involved expensive transportation of products to distant markets. Now a turbine and a generator at the waterfall may supply cheap power to a factory a hundred miles away, and to hundreds of intervening small power users.

The possibilities of electricity in the next century baffle the imagination; but we have the word of no less an authority than Charles P. Steinmetz that they will far eclipse the achievements of the last hundred years.

(*Turn to page 137*)

# Power and Light from the Limitless Winds

By F. A. Platte

*Instructor, Department of Physics, Columbia University*

IN THE light of present-day developments in methods of capturing and utilizing natural sources of power, most persons probably look upon the windmill, devised by man some time prior to the twelfth century, as hopelessly obsolete, except in isolated sections. Yet, in the opinion of leading engineers, this is far from being the case.

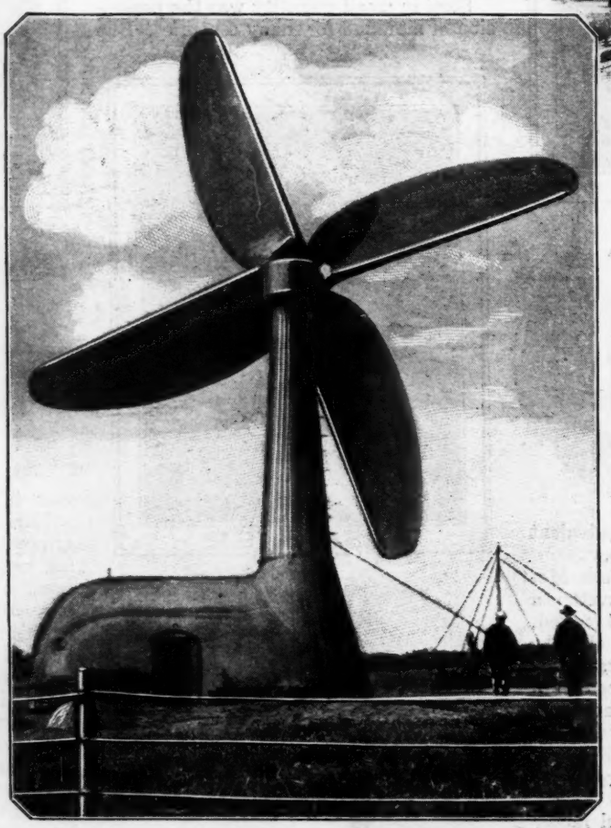
Improved windmills, they say, not only are valuable adjuncts to modern power-generating devices, but they possess individual merits of their own. In fact, they are so useful for many sorts of power work that they may find more extensive use in the future than in any period in history.

## *May Drive Locomotives*

A striking example of the possibilities of the modern windmill is found in East Prussia, Germany. There 11 windmills of the type pictured on this page have been constructed recently to supply electric power during the existing coal shortage. So efficiently have the wind motors operated in supplying current for electric light and to run irrigation machinery, that steps now are being taken to use wind-generated power to drive locomotives of a local railroad that was forced to suspend because of the nationwide coal shortage.

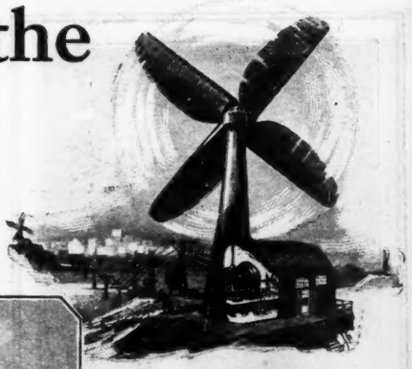
The power generated by revolution of the windmill wings turns a dynamo, and the energy produced is held in storage batteries. This method of transforming the power of the wind into electric current has been employed before in this and other countries, but the wind motors constructed in Germany are unique in many important particulars.

For one thing, the new windmill, unlike all other types, requires no indicator, or tail, to keep it headed to the wind, and its blades always present their maximum surface to the wind. Its wind wheel is self-adjusting. Such an effect is produced by having the blades turn about a revolving wheel that rests on ball bearings and automatically keeps its axis at right angles to the direction of the wind. This feature permits the wind wheel to utilize the entire force of the wind for power production. In the picture at the top of this page the wind is blowing from the direction of the observer. Under the same conditions in any other type of windmill the wind wheel would be on the observer's side of the tower.



This photograph shows one of the giant windmill power stations established in East Prussia to generate electricity for light and power during coal shortage. They may be used to run railway trains

The design of the wings is simple yet original. Every known scientific fact regarding windmills and wind motors was taken into consideration in their construction in order to produce maximum power from minimum air movement. The wings were designed by a noted manufacturer of airplane propellors, and were tested in the aerodynamic laboratories at Göttingen, Germany, before installation.



Our artist's conception of the wind-motor system, showing the inside of the power plant and transmission lines

## *Moved by Light Breeze*

A breeze barely sufficient to stir the leaves of the trees will set the great wings in motion, although the circle they describe is almost 60 feet in diameter. Once started, they will continue to revolve as long as there is the faintest movement in the air. A normal wind will produce about 40 horsepower and a strong wind 70. On days when every other windmill near by is still, those of the new design are supplying power.

An ingenious "brake" prevents the arms from turning too rapidly in a gale. At the tip of each arm is a disk that rises from centrifugal force as the speed of the wings increases and opposes their motion. The faster the wings turn, the farther out these disks extend, so that no matter how strong the wind, the speed of the wind wheel is always kept within reasonable bounds.

The towers upon which the arms are mounted are about 50 feet high. They are cylindrical in shape, built of iron and cement.

The construction cost of the wind motors is said to be relatively low, considering the amount of power they produce. American and European engineers are watching the new method of harnessing the wind with eager interest. They see in it a valuable auxiliary to our present methods of producing electric power.

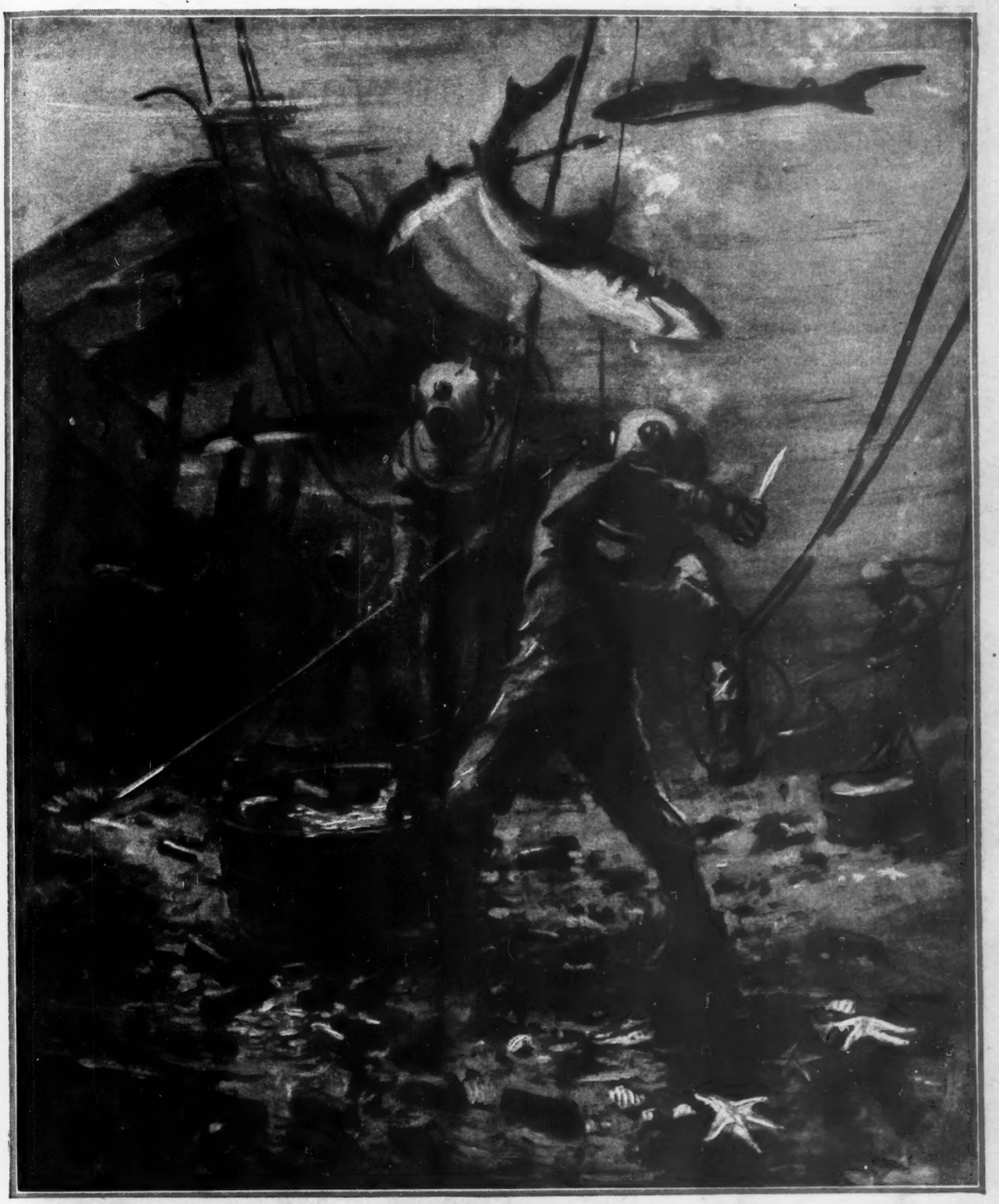
A resident of East Cleveland, Ohio, who lights his home with power generated by a windmill of a different type, described on page 69 of this issue, testifies to its efficiency and economy.

### "Wind Power a Substitute for Coal"

**JAMES LORING ARNOLD, professor of electrical engineering at New York University, commenting on the German wind motors described on this page, says:**

**"Utilizing the wind as a source of electric power is entirely feasible from an engineering point of view. The supply of electricity, of course, would vary according to the prevalence of wind, but the energy produced could be handled exactly as in the automobile, where the generator speed varies with the rapidity with which the car is moving. That is to say, the intermittent power could be led into storage batteries from which electricity at constant voltage could be procured for motors and lights.**

**"The principal reason why we have not utilized the wind for the production of electric power in America is that the installation of windmills is expensive when compared with cost of coal and water plants. Also, coal and water assure us of constant power. But should coal become too expensive or should there be a dearth of it such as now exists in Germany, we might have to turn to intermittent wind power."**



# Divers Battle Hungry Sharks to Spear Sunken Gold

IN THIS picture our artist portrays vividly the dramatic adventures of divers in their hunt for the $30,000,000 of golden treasure that dropped into the ooze of the ocean bed when a German submarine sank the White Star liner *Laurentic* off the Irish coast during the war.

Battling ferocious sharks with knives, 90 feet below the surface of the sea, these intrepid deep-sea hunters have succeeded in recovering all but 30 bars of the gold bullion that was being carried to American bankers when the *Laurentic* went to the bottom.

As they grope among the bones of the sunken ship, the divers use a sensitive divining spear, with galvanometer dial attachment, to prod for the golden bars in the mud and silt. Whenever the spear strikes a metal object, the clocklike dial aboard the salvaging ship *Racer*, indicates whether the spear point is touching gold or a base metal such as iron. The diver then receives his directions by telephone from the salvaging ship. The gold bars, as they are located, are raised in a tub.

In this way nearly 3000 gold bars, worth from $5000 to $10,000 each, have been salvaged from the deep.

# His Hobby—a Two-Mile "Vest Pocket" Railway

## *How W. Cecil Gage Built a Toy Road from Odds and Ends*

Approaching one of the eight switches of the "Cecilwood Vest Pocket Railroad." The rails are made from two-by-fours from a dismantled henhouse, while the ties are from floor beams of the same building

**By Raymond J. Brown**

SEVEN years ago W. Cecil Gage, then an insurance broker in New York City, attempted to retire from business. He removed to a country estate at Fishkill, N. Y., and prepared to settle down to the life of a country gentleman.

But his attempt to retire proved unsuccessful. Through an odd combination of circumstances he has gone into the railroad business. He owns and operates probably the most remarkable railroad in the world—a complete miniature system, with two miles of track. And every inch of that track, every one of the nine pieces of rolling stock that pass over it, he built himself almost entirely from secondhand materials.

W. Cecil Gage at the throttle of his eight-horsepower gasoline locomotive, taking members of his family for an afternoon ride

**"THERE was a time," says Mr. Gage, "when I wondered what value my friends could derive from their endless pursuit of golf, fishing, photography, working with tools—whatever it was they rode as a hobby. Now, though, I understand; for from my railroad—my first and only hobby—I have taken more enjoyment and valuable recreation than anything else ever has given me."**

### *An Economical Road*

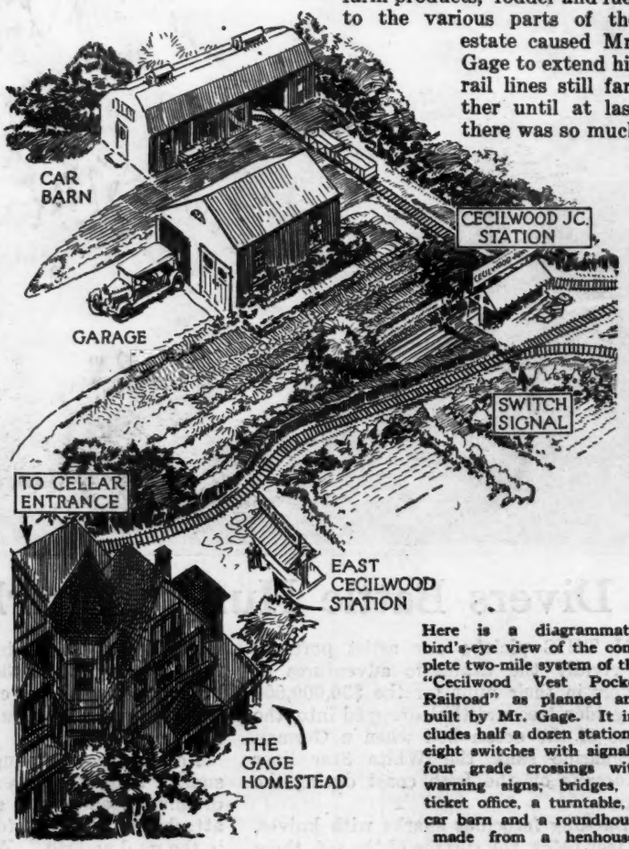
The gasoline motor that drives the locomotive, the car wheels—narrow-gage trucks of the type used for mine cars—and the strap-iron reinforcement on the wooden rails represent the only purchase Mr. Gage made in the construction of his railroad. Everything else—cars, rails, ties, switches, and the single trestle that bridges a brook—is made of discarded lumber and metal, picked up around the estate.

Started as a convenience and pushed to completion as a hobby, the Gage narrow-gage road, which its owner calls the "Cecilwood Vest Pocket Railroad," now is a commercial enterprise, paying substantial dividends from passenger fares. At the same time it serves its original purpose of supplying a swift and convenient means of carrying farm products, fuel, and similar materials around the Gage estate. From every part of the country surrounding Fishkill, by motor, foot, trolley, rail, and ferry, almost a constant stream of persons of all ages pours into Cecilwood to make the circuit of the big Gage farm in the tiny cars. Mr. Gage estimates this year's mileage record of his little road to be well above 10,000.

The Vest Pocket Railroad owes its construction to the difficulty Mr. Gage encountered in disposing of the ashes from his household furnace during his first winter in Fishkill, when he found it necessary to carry the ashes about a quarter of a mile to dump them. Although he never before had tried to build anything, he constructed a little car, similar to a railroad flat car, in which to haul the ashes. Then, because uneven ground made the operation of this car decidedly unsuccessful, he conceived the idea of running his car on rails.

These rails he constructed of "two-by-fours" that had formed the framework of a dismantled henhouse, and he mounted them on ties sawed from the floor beams of the same structure. During that winter his ash car, which he pushed back and forth with a pole, did valiant service. Meanwhile the ashes were utilized as ballast for the newly constructed tracks. In the spring Mr. Gage extended his tracks another quarter mile or so and built a second car. Both of the original cars are still doing freight service.

The necessity of conveying farm products, fodder and fuel to the various parts of the estate caused Mr. Gage to extend his rail lines still farther until at last there was so much




Here is a diagrammatic bird's-eye view of the complete two-mile system of the "Cecilwood Vest Pocket Railroad" as planned and built by Mr. Gage. It includes half a dozen stations, eight switches with signals, four grade crossings with warning signs; bridges, a ticket office, a turntable, a car barn and a roundhouse made from a henhouse

Hauling in the winter supply of firewood on midget flat cars

track that a locomotive was necessary. For a power plant for this locomotive, he bought an eight-horsepower gasoline motor of the type used to operate railroad hand cars. This proved successful in operation, and soon the task of extending and improving his little railroad became Mr. Gage's absorbing hobby, occupying all his spare time.

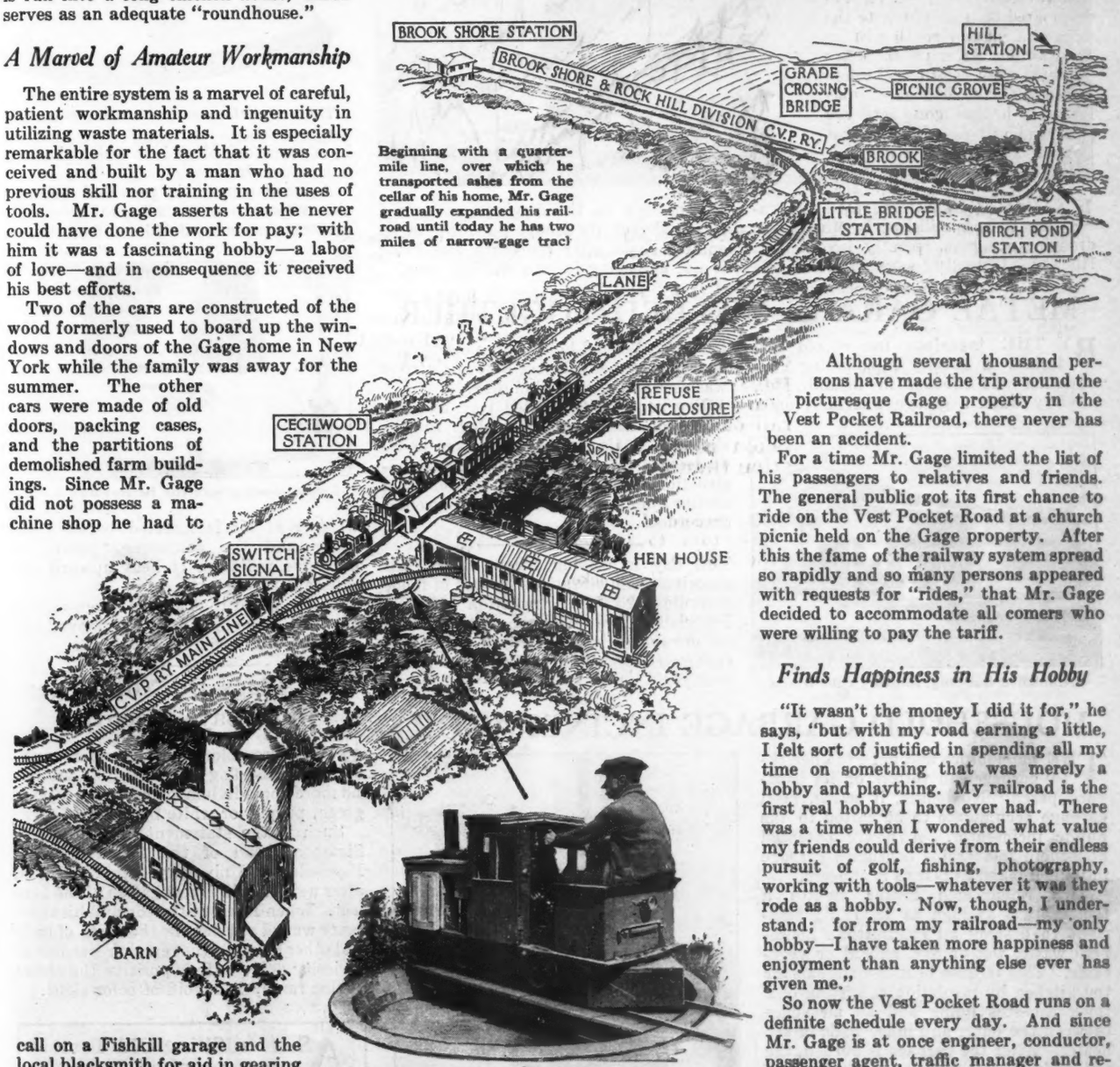
Little by little the road grew during the six years that followed, until now it has two miles of track, five passenger cars, two flat cars, a freight car, eight switches, four crossings, equipped with warning signs; a turntable, a snow plow, a ticket office and a half dozen stations. At night or during severe weather the rolling stock is run into a long chicken house, which serves as an adequate "roundhouse."

Visitors flock to Cecilwood to ride around the big Gage farm in the tiny passenger cars

## *A Marvel of Amateur Workmanship*

The entire system is a marvel of careful, patient workmanship and ingenuity in utilizing waste materials. It is especially remarkable for the fact that it was conceived and built by a man who had no previous skill nor training in the uses of tools. Mr. Gage asserts that he never could have done the work for pay; with him it was a fascinating hobby—a labor of love—and in consequence it received his best efforts.

Two of the cars are constructed of the wood formerly used to board up the windows and doors of the Gage home in New York while the family was away for the summer. The other cars were made of old doors, packing cases, and the partitions of demolished farm buildings. Since Mr. Gage did not possess a machine shop he had to call on a Fishkill garage and the local blacksmith for aid in gearing the motor of his locomotive to the axle; but all the rest of his railroad represents the work of his own hands, aided by an ordinary kit of carpenter's tools.




Beginning with a quarter-mile line, over which he transported ashes from the cellar of his home, Mr. Gage gradually expanded his railroad until today he has two miles of narrow-gage track



Gage and his locomotive on the tiny "roundhouse" turntable. Note the automobile spotlight that serves as the rear light; also the pipe smokestack

The rails, 14 inches apart, are painted and tarred and protected on their inner top edges by strap iron. Except for the metal strip they are of wood. Comfort for the passengers is assured by elliptical springs on which the seats are mounted. The cars are about five feet long. Each is mounted on four eight-inch wheels, the axles being set close together to enable the cars to take curves without overturning.

Although several thousand persons have made the trip around the picturesque Gage property in the Vest Pocket Railroad, there never has been an accident.

For a time Mr. Gage limited the list of his passengers to relatives and friends. The general public got its first chance to ride on the Vest Pocket Road at a church picnic held on the Gage property. After this the fame of the railway system spread so rapidly and so many persons appeared with requests for "rides," that Mr. Gage decided to accommodate all comers who were willing to pay the tariff.

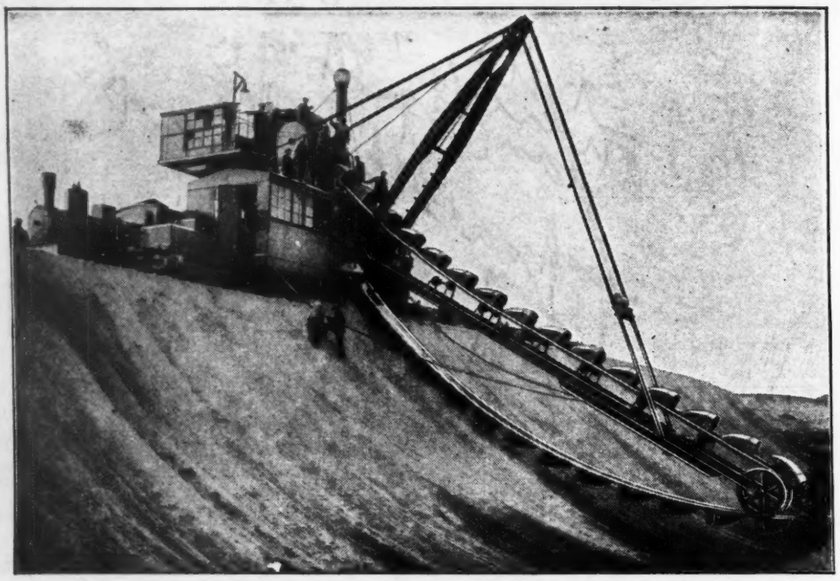
## *Finds Happiness in His Hobby*

"It wasn't the money I did it for," he says, "but with my road earning a little, I felt sort of justified in spending all my time on something that was merely a hobby and plaything. My railroad is the first real hobby I have ever had. There was a time when I wondered what value my friends could derive from their endless pursuit of golf, fishing, photography, working with tools—whatever it was they rode as a hobby. Now, though, I understand; for from my railroad—my only hobby—I have taken more happiness and enjoyment than anything else ever has given me."

So now the Vest Pocket Road runs on a definite schedule every day. And since Mr. Gage is at once engineer, conductor, passenger agent, traffic manager and repair crew, he asserts that the "retirement" which he went to Fishkill to find is largely figurative.

Operating the train and keeping the system in repair engage him from morning to night, seven days a week. He declares that he has less leisure time now, in his "retirement," than at any stage of his business career.

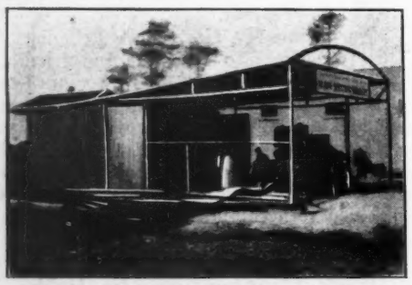
# GIANT EXCAVATOR DIGS FROM ABOVE



EXTRAORDINARILY rapid excavation is accomplished by this giant dredging machine recently invented in Holland. Instead of working in the hole and passing up the diggings, as does a steam shovel, its scoops go down in an endless chain after the earth and bring it up, emptying it into waiting cars.

# METAL GARAGE WELDED TOGETHER

BY THE ingenious use of old materials, a novelty in building construction was effected in Miami, Fla., recently when a garage was built on a framework of old boiler tubes electrically welded together. Not a bolt nor a rivet was used in the entire building.



Unfinished building, showing tube frame

The roof of corrugated iron and the sheet-iron sides were welded to the skeleton. This building, which is 18 by 36 feet, is shown here while under construction. It is planned to erect a similar building 50 by 150 feet in ground dimensions.

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THE day is coming when diners will absorb electric vibrations instead of food, according to the prediction of Dr. Francis A. Cave of Boston, Mass. We'll eat our meals by attaching to our bodies apparatus connected with electric wires, he says.

# HOUSEHOLD GARBAGE INCINERATOR

THE malodorous and none too healthful garbage can totters on its backyard perch. No longer, it seems, need garbage accumulate to be carted to the public incinerator. A newly patented household incinerator consumes garbage in your kitchen as fast as it appears.

This remarkable heater creates a temperature as high as 1200° F., sufficient to destroy all combustible household waste, wet or dry, animal or vegetable. This intense heat is made safe for the kitchen by insulation consisting of a thick asbestos lining and an air space between the outer and inner walls of the heater. After the garbage is burned, the residue is a small quantity of odorless and sanitary ash, which may be kept in the incinerator until enough has accumulated to justify emptying it.

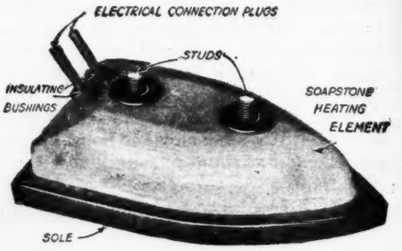
It is claimed that five cents' worth of gas is sufficient to destroy a bushel of garbage, the time required being less than one hour. On the issue of economy alone, the invention is a success.

Intense heat burns up all garbage

## Soapstone Electric Iron Conserves Heat

A NEW type of electric iron has been designed to conserve heat by taking advantage of the heat-storing qualities of soapstone, a substance once used for foot-warmers, bed-warmers, etc.

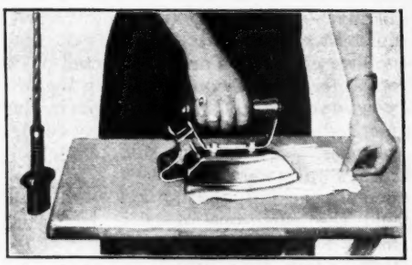
The ironing surface of the invention is a relatively thin metal sole, surmounted




The iron with soapstone heating element

by a soapstone block into which the heat is conducted.

A close contact is provided between the soapstone and the metal sole. To protect the housewife's hand from burns,



Insulation protects the housewife's hand

a layer of air is inserted between the cover and the soapstone, preventing excessive radiation of heat upward and sideways through the cover.

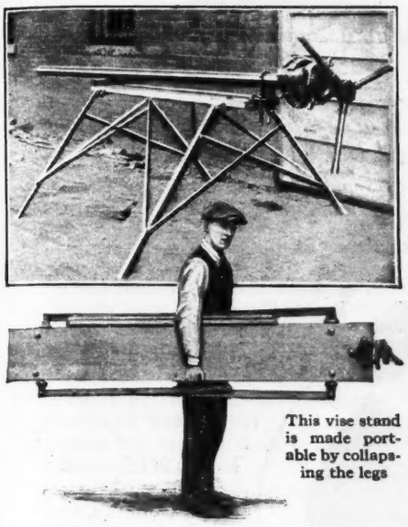
It is claimed that after a seven-minute connection the plug may be removed and ironing continued for 45 minutes.

## Red Flags Do Not Anger Bull, Says Scientist

BULLS are color blind; therefore, waving a red flag before a bull arouses no more anger in him than waving a pink, green, purple, or white flag.

Such is the statement of Dr. G. M. Stratton, head of the Department of Psychology, University of California, after a six-month investigation of the subject. When Doctor Stratton and his assistants waved red flags in the faces of bulls and other animals, the reaction was one of curiosity only. He is positive the entire bovine family is devoid of color sight.

**AS IF fulfilling Old Testament prophecies, modern science is preparing to harness the River Jordan to rejuvenate Palestine — the Land of Promise. This gigantic engineering project will be described dramatically in next month's issue.**



This vise stand is made portable by collapsing the legs

## Portable Vise Stand Has Collapsible Legs

THIS portable vise stand, designed to save steps for plumbers and steamfitters handling lighter sizes of pipe, consists of a stout plank firmly supported by braced collapsible metal legs. The wide spread of the legs affords steadiness while cutting or threading pipe. A hinged pipe vise is attached to the plank.

## Four-Deck Stove Saves Heat

UTILIZING heat that usually is wasted up the chimney, a new type of stove permits gases formed in combustion to escape only after they have given up all their heat.

After passing beneath the primary cooking surface the heated gases are circulated through a series of metal boxes, the tops of which serve as successive cooking surfaces. From the third box the gases pass up the chimney.

The new four-deck heating system applied to cook-stove (above) and heater (at the left)

# AIR GUN PASSES WHITE HOT RIVETS

THE danger from white hot rivets, speeding from the tongs of the heater boy and sometimes eluding the bucket of the passer, has been eliminated by the perfection of a pneumatic rivet-passing system, in which the rivets are shot by compressed air to their destination through a flexible metal hose.

Pneumatic passers now in service can send rivets for a distance of 150 feet. The metal hose may bend around corners between the passer and the discharge end without stopping the passage of the rivets.

To start a rivet on its way, the heater boy drops it upon a balanced check valve that allows it to fall into the admission end of the hose. Then, when he presses on a pedal, a blast of compressed air is released from a reservoir, blowing the rivet swiftly to the other end of the hose. Meanwhile the quick expansion of air tends to cool the hose.

Above: Starting a rivet on its way through the metal tube. At right: The receiving terminal, showing how a cushioning disk receives the impact of the rivet

Reaching its destination, the rivet enters a receiving chamber, where a cushioning disk prevents it from being deformed by the sudden impact.

Besides assuring safety for structural workers, the pneumatic system eliminates the usual waste of misdirected rivets that are seldom picked up and used.

# CABLE CARRIES MAIL ACROSS STREAM

AN inventive farmer living in a rural district of California has insured prompt delivery of his mail, at the same time performing a kindness to the letter carrier, by constructing the novel mailbox carrier shown here.

To reach his home, mail must be conveyed across a river 300 feet wide, and in times of high water the nearest crossing is more than a mile away. Cable lines and an old-fashioned bicycle wheel converted into a pulley, solved the problem.

The mailbox is suspended from a carrier cable by means of two small wheels attached to the top of the box. The lower part of the box is attached to a second cable running over the bicycle wheel pulley. Thus, when the operator turns the pedals of the wheel, the box is carried across stream along the top cable.

After the mail carrier has deposited letters in the box, it is hauled back, coming to rest inside a heavy strip of tire iron bent over a post.

A fence prevents stray cattle from running into the cable lines.

At the left is shown the mailbox being conveyed across stream on carrier and pulley cables. Below: The pulley, made from an old-fashioned bicycle wheel, and the mailbox carrier system

**"WHAT My Hobby Has Done for Me," is the title of an unusual article by Arthur Stringer, popular American novelist, to appear in next month's POPULAR SCIENCE MONTHLY. His hobby is—well, see the January number.**

# Nine to One Your Eyesight Is Pulling You Back

By Guy A. Henry

*General Director, The Eyesight Conservation Council of America*

IF YOU never have had to lay aside a book in the most interesting part of your evening's reading because your eyes would not "carry on," you are one of the fortunate few. Even so, the chances are at least nine to one that you have defective eyesight.

This statement may startle you. You may deny—probably indignantly—that you ever had any trouble with your eyes. You may say that they have always seemed adequate for your use. But, provided that you are more than 21 years of age, the chances are even greater than nine to one that some degree of trouble is there, whether you know of it or not.

That eyesight influences the efficiency of the mind has been determined by this test with the Galton Bar, a device that measures ability to perceive small differences in length

For it is only up to the age of 21 that this proportion holds true. Beyond that age, the prevalence of eye defects increases, until at the age of 40 scarcely a man or woman has perfect eyesight.

But you needn't be unduly alarmed. Science knows all about your difficulties, even if you are unaware of them yourself, and has provided ready relief in the shape of proper glasses. You may not even need glasses. Probably a little rest for your eyes now and then and the correction of some of your habits in reading or working may rid you of small defects that, while not warranting the wearing of glasses, may be responsible for headaches and other disorders of a nervous character.

## *Eye Strain Is Wasteful*

If your troubles are thus lightly corrected, you are to be congratulated. Statistics covering a long period of years, borne out by a recent investigation among more than 10,000 employees of industrial and commercial concerns, show indubitably that not less than 66 men and women out of every 100 you know are so crippled by defective vision as to cause an appreciable economic waste. There is no physical defect that contributes more directly to inefficiency and is more responsible for waste of vitality, effort, time, and material than bad eyesight.

Not long ago I met on the street a man whom I have known for years, an executive of a large insurance company. Usually good-natured and happy, that day he wore a black scowl and his greeting was anything but cordial.

While chatting with him I learned the reason for his ill humor. He had just had his eyes tested and had been informed that glasses would supply the only remedy for the headaches and fatigue that had been annoying him.

"Glasses!" he growled to me. "I don't need glasses any more than I need crutches! I'm not an old man—only 38. That eye man is an idiot!"

My friend's attitude is typical of that displayed by many persons in his position. They resent being told they need glasses. They feel they are being classified with the aged and the infirm. They fail to understand that glasses are the only means that science provides of correcting certain defects in the physical structure of the eye, from which many persons—between 25 and 60 per cent, according to the findings of school examiners—suffer either early in life or later.

Even more numerous than those who know they should wear glasses and will not are those who are unaware that they need glasses. A person whose eyes have been defective since early life is likely to remain ignorant of the defect unless he is informed of it. Accustomed to seeing things blurred and indistinct, it never occurs to him that his visual pictures may be different from those of other people.

Recently a man of about 35 told me that the best years of his life had been wasted as a result of his failure, through ignorance, to correct a defect in eyesight. As a schoolboy he had been "backward." Later he had shown little aptitude for work, drifting from job to job until the war came and he was drafted. An army examiner discovered that he was suffering from a severe case of astigmia. Proper glasses were provided and he saw the world through different eyes.

As a result, since this man's discharge from the army he has become an expert machinist. He is making up the deficiencies in his education by studying at night, and is slated for advancement by his employers. All of this he might have accomplished years ago had any one discovered his handicap.

## How to Save Your Eyes

**DID you know that severe eye strain may cause you to use up fully half the vital force intended for all the organs of your body, draining the resources of your mind, your muscles and your nerves and producing severe fatigue?**

**To avoid misuse of the eyes, with its consequent ill health, medical science offers these suggestions:**

**Don't read or work in insufficient light. In well-illuminated places avoid the glare of lights shining directly into your eyes.**

**Don't read on street cars or buses.**

**Rest your eyes at the first sign of fatigue.**

**Be sure that your work is not at an uncomfortable angle with the line of eyesight.**

**Have your eyes examined by a competent practitioner for the correction of physical defects.**

**Don't refuse to wear glasses if you need them.**

## *Common Eye Troubles*

You may wonder why I lay stress on the use of glasses. I do so because they are the only sure means provided by science to aid the five common eye troubles that are due entirely to physical defects in the structure of the eyes. These are:

Far sight—caused by the eyeball being too short.

Near sight—caused by the eyeball being too long.

Astigmia — caused by the transparent front of the eye curving more in one direction than in another.

Natural changes in the eye, occurring some time after 40 years of age, and usually necessitating the use of glasses for reading and other near work.

Eye strain, resulting from the extra work that we compel our eyes to do in an effort to contend with insufficient and flickering light, glare and too long periods of near use without intervals of rest.

These errors in many instances are serious, causing headache, eye ache, and various nervous disturbances. Moreover,

## Where Defective Vision Takes Its Toll

**EXAMINATION of thousands of school children in the United States has revealed that between 25 and 60 per cent of the defective vision from which practically all of us suffer, comes during our schooldays, largely through faulty illumination.**

**In the workshop, with its artificial illumination, 66 men and women out of every 100 are handicapped in their work by defective vision. Bad eyesight is directly responsible for enormous waste of energy, time, and material.**

**Examine the two photographs below—one showing how a watch appears to normal eyes; the other, how it appears to defective eyes—and you will understand why many of us, accustomed from childhood to seeing things blurred and indistinct, go through life in ignorance of the faulty vision.**

if the condition is permitted to endure for years, partial or total blindness may result from cataract, a disease that authorities agree frequently is the direct result of continued eye strain in the earlier years.

The abuse that the eyes of the average person receive has increased in the last couple of generations to a degree beyond estimation. Artificial illumination and the resulting pressure of modern commercial and industrial life are largely responsible for this increase. One naturally would suppose that modern improvements in artificial illumination would have made it somewhat easier for the eye to support its additional burden.

But such is not the case. The average eye has been unable to keep pace with the demands resulting from the extraordinary development in such illumination of the last 25 years. It has resented the additional work that has been placed upon it, and the result has been disorders, many of which people do not attribute to their eyes.

### *Conserve Your Eyes*

We cannot, of course, reduce the speed and pressure of modern life even in deference to so important a thing as our eyesight. There remains, then, only one thing to do—make the best of modern conditions and learn how to use our eyes and not abuse and misuse them.

The first thing I should advise is periodic examination of the eyes by a competent refractionist — some one skilled in the science of measuring the human eye. Certainly you should have your eyes examined if you have never done so, for you may be contending unaware with eye strain, near sight, far sight, or astigmia. But avoid those who offer treatment by mail.

When using artificial light, see to it that the illumination is sufficient. What apparently is too much light is better than too little. Poor light will cause strain even to a normal eye, while there is little danger in over illumination, provided it is not accompanied by glare. The most common form of glare is that resulting from light shining directly into the eyes.

Glare is the greatest danger of artificial light, and may be minimized by shades and the use of proper glassware to modify and diffuse the light. Bare lights should not be tolerated. The slightest sign of fatigue, such as drowsiness or smarting of the eyes, is a warning for you to rest your eyes.

That there is a definite connection between the eyes and the stomach is indicated by the fact that the nausea accompanying "car sickness" is attributable to the unnatural movements of the eyes caused by the vibrations of the car. In fact, general health and the eyes are closely associated. Defective eyes frequently are the cause of many disorders.

If one of these watches appears distinct, the other blurred, your eyesight is normal. If both appear blurred, your eyesight is defective

### *Science Offers Hope*

Even though the eyes of most of us will not register "normal" in examination, our plight is by no means hopeless. The human body always has managed to adjust itself to changing conditions of life. The adjustment, though, requires time. We of this generation are forced to bear the burden of a sudden change in our mode of life, caused by the demands of modern life and the recent development in the science of artificial illumination. That our eyes have not yet contrived to adapt themselves to the new conditions is not remarkable. But they will—if given time.

If people will take care of their eyes, use them and not misuse them, and exercise judgment and reasonable precautions, it is quite safe to predict that, despite the strain and pressure of our modern life, our eyes will not grow worse, but grow better.

The new safety system for bank vaults. Accidental locking of the door automatically summons aid. A tank supplies oxygen until rescuers arrive

# If You Were Locked in a Bank Vault

WHAT if you were locked accidentally behind the thick walls of a steel bank vault? Can you imagine the horror of shouting vainly for help; the agony of the long night hours of waiting, with hope ebbing and the torture of slow, suffocating death creeping upon you?

The frequency, in recent months, of such tragedies with their untold mental and physical suffering, has led Alfred C. Bossom, a New York architect, to invent an automatic oxygen releasing device designed to save the victims of accidental imprisonment from suffocation. Mr. Bossom has supplied full specifications of his invention to American safety organizations, and the first complete apparatus now is being installed by an Ohio safe company in the new building of the Texas Bank and Trust Company, Galveston, Tex.

In the new safety system, dramatically pictured above by our artist, the locking of the vault door automatically switches on an electric light within the vault. This light illuminates a card on which are printed instructions, at the same time revealing an oxygen tank close by. The accidental locking of the door also flashes an alarm signal, summoning police detectives.

Acting on the printed instructions, the involuntary prisoner twists a stopcock on the oxygen tank, permitting the life-giving oxygen to escape into the vault at a pressure not exceeding 10 pounds. In very small vaults the prisoner puts on a mask connected with the tank; but in larger vaults the oxygen is allowed to escape directly into the room. A telephone permits the prisoner to communicate with his rescuers.

A small tank, it is claimed, will supply sufficient oxygen for the prisoner for at least 12 hours.

Many recent instances of imprisonment in bank vaults have escaped public notice, according to Mr. Bossom, only because they have not resulted fatally. In nearly every one of these accidents the victim, when released, has been in a state of collapse after a night of terror. In one recent case, a young clerk who was locked in a trust company vault at Paterson, N. J., had torn his finger nails and bruised his body by beating on the thick walls of his chilled steel prison.

## HOW MANY OF THESE QUESTIONS CAN YOU ANSWER?

EVERY mail brings us scores of questions on mechanical and scientific subjects from POPULAR SCIENCE MONTHLY readers. While the questions touch on every phase of science, mechanics, and natural history, there are numerous duplications and from those, as indicating the widest general interest, have been selected the following twelve.

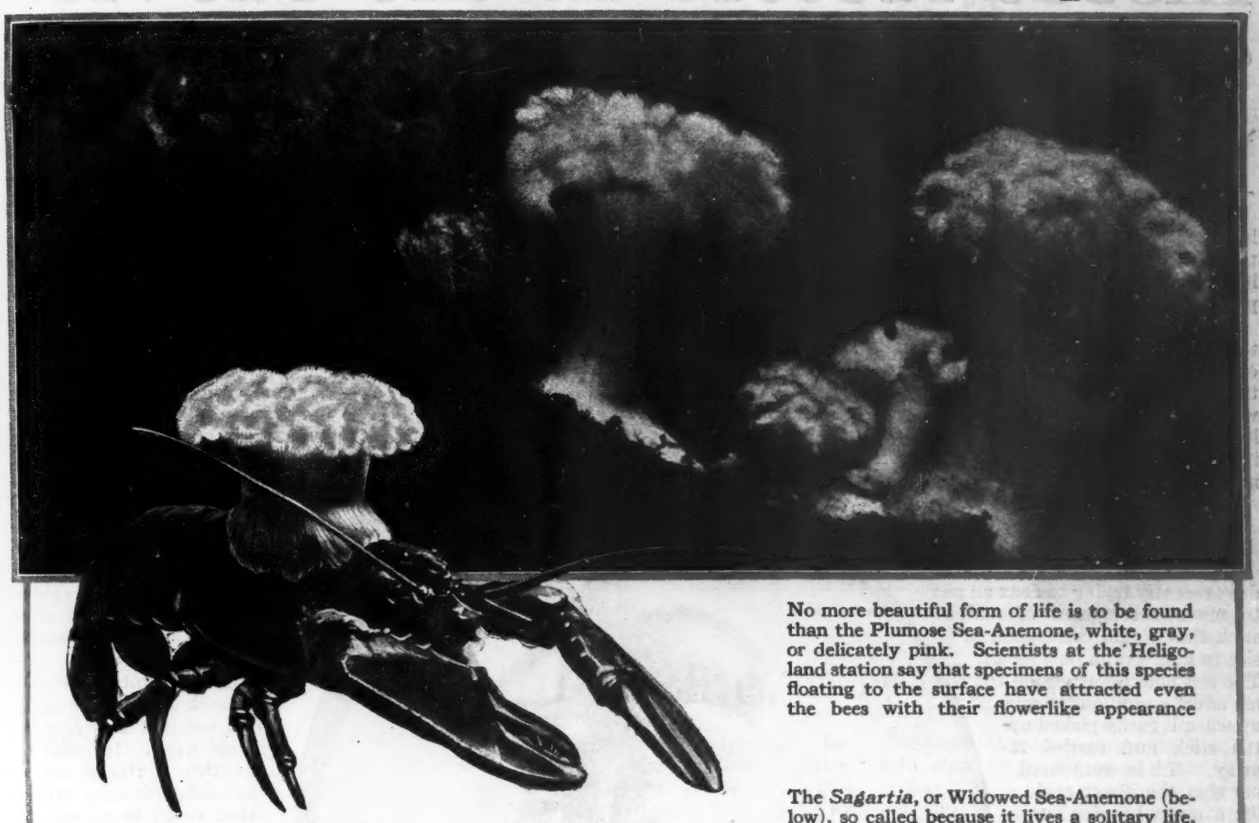
Our Information Editor has compiled thousands of answers to questions submitted by our readers. From these, other "monthly dozens" will be published every month in POPULAR SCIENCE MONTHLY.

How many of these questions can you answer correctly? To test yourself, answer each one of them to the best of your ability. Then turn to page 139 and read the correct answers.

See how near you can come to a perfect score. You'll find it an interesting game, and at the same time you'll be absorbing valuable knowledge.

1. *Are there any creatures that live forever?*
2. *Can submarines receive radio messages?*
3. *Why does soap help to remove dirt?*
4. *What is the cause of earthquakes?*
5. *Are there special brain foods?*
6. *Why is Maine colder than France, although about equidistant from the equator?*
7. *Why can a bird stand on a charged trolley wire without getting a shock?*
8. *Are modern men less healthy than prehistoric men?*
9. *Where did the Red Indians come from?*
10. *Why does food continue to cook after it is placed in a fireless cooker?*
11. *What happens in your brain when you go to sleep?*
12. *How strong must an electric current be to cause death?*

# A "Flower Show" of the Deep Sea



Here is a deep-sea taxi ride—a slow moving Sea-Anemone being transported on the back of the comparatively swift lobster

No more beautiful form of life is to be found than the Plumose Sea-Anemone, white, gray, or delicately pink. Scientists at the Heligoland station say that specimens of this species floating to the surface have attracted even the bees with their flowerlike appearance

The *Sagartia*, or Widowed Sea-Anemone (below), so called because it lives a solitary life, resembles some exotic tropical plant. Its beauty is a trap, for each of its delicate tentacles is a poisonous barb that seizes and stings to death any smaller creature within reach

AT THE bottom of the sea the plants are animals. Strange though this may seem, science proves it to be literally true. Vegetation is to be found only near the surface of the ocean. The flower-like life of its vast depths, rivaling in beauty the choicest products of the greenhouses and cultivated gardens of the land, is animal life.

The remarkable pictures on this page were photographed by scientists of the biological station at Heligoland. Extraordinary patience and skill were required to get the subjects, in all their natural beauty, into shallow water where light could penetrate.

This might be mistaken for a beet, or possibly an onion. Actually, though, it is a photograph of the Compass Jellyfish, with opalescent floating veils of unusual beauty and coloring

At the left are two Sea-Cucumbers, among the strangest of all strange ocean creatures. They are cousins to the Starfish, shown here paying them a friendly visit, and to the Sea-Urchin and the Sea-Apple. Chinese epicures frequently pay high prices for Sea-Cucumbers



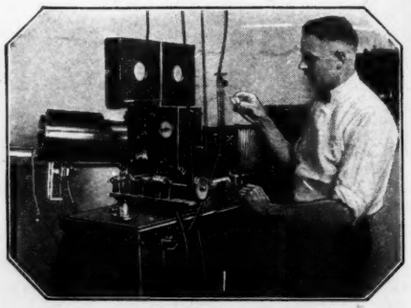
combs. Their work showed a perfec-

In ordinary photography—except in

# Insect Actors in the Movies

## *Camera Shows Wonders of Microscopic World*

**By Louis H. Tolhurst**



Photographing insect "actors." Here is Louis H. Tolhurst, of Los Angeles, Calif., at work with the apparatus he has invented to make microscopic movies of insect life

IMAGINE tossing a 120-ton locomotive up on your back and walking off with it!

You could do it if you had the strength, in proportion to your size, possessed by the ant. This has been demonstrated in my work with insects incidental to photographing them for the screen.

You have seen an ant crawling along the ground carrying a chip, breadcrumb, or some other burden that was a dozen times its own bulk, and probably you have wondered just how much that ant could lift in comparison with yourself. I was interested in this, so I made an experiment.

### *Coaxing an Ant*

I pent the better part of three days recently trying to coax an ant to move a fragment of match stick that would correspond in size to a telegraph pole for us. The ant paid no attention to me and I was about to give up when it easily picked up the stick and carried it away. This convinced me that the insect could lift a much heavier burden, so I fashioned a tiny telegraph pole, tied it in the middle with a piece of grass, suspended the ant from a loop of string and after repeated trials succeeded in inducing it to take hold of the grass bridle.

The ant lifted the pole clear of the table with its mandibles—*with its teeth!* Considering the weight of the ant, that pole represented a burden of 240,000 pounds, or 120 tons, for you or me!

Consider a crew of workmen swarming over a building carrying a few bricks at a time, while puffing engines with derricks swing the heavy girders into place. Then consider ants of the stature of men, with their tremendous strength magnified in proportion to their increased size! The ants would have no need of derricks. They would handle steel girders as we handle toothpicks, each insect would be capable of carrying a carload of bricks up a ladder! Man's prowess would be insignificant in comparison.

### *Wonders of the Insect World*

There is an old saying that the man who lives in the world of the telescope lives in a very small world, while he who lives in the world of the microscope lives in a mighty, majestic world.

Scientists who recently photographed the sun can attest to the first half of the saying and I am a firm believer in the latter half. For 10 years my work has consisted almost entirely of observing and photographing insects, first in still pictures and recently on motion-picture film, and the better I become acquainted with my insect subjects, the more I marvel at their wonders and capabilities. The strength of the ant was a revelation to me, but that was only one of the wonderful things I learned about insects.

The spider, for example, demonstrated that as a spinner of silk he was much more proficient than man with his old-fashioned spinning wheel.

All photos courtesy Principal Pictures Corp.

Highly magnified view of the dramatic insect movie photograph above, showing a common red ant lifting a miniature telephone pole with its mandibles. If a man had the same strength in proportion, he could lift a 240,000-pound locomotive

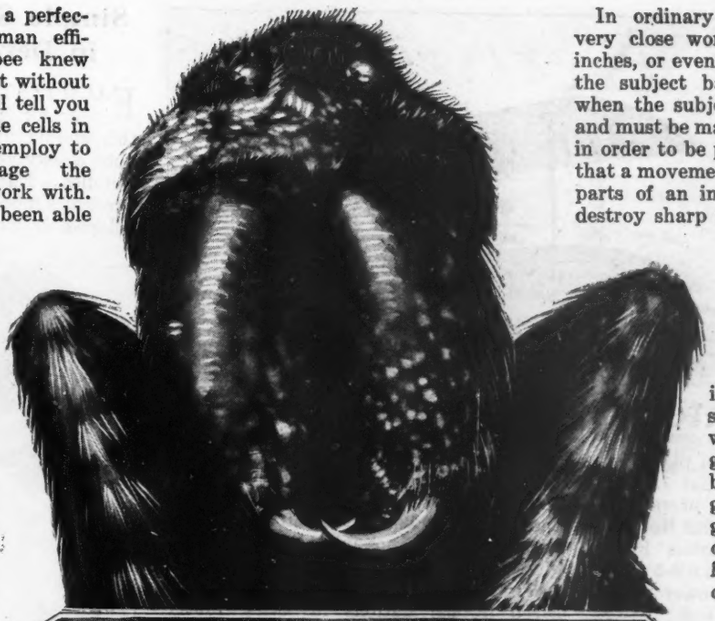
You have seen the house spider dangling at the end of his string, and probably you have observed how fast he can move with it. I have spent hours watching spiders build their webs. One day I destroyed a web and the spider quickly rebuilt it. I did this again and again and the spider demonstrated he could spin almost as fast as I could destroy.

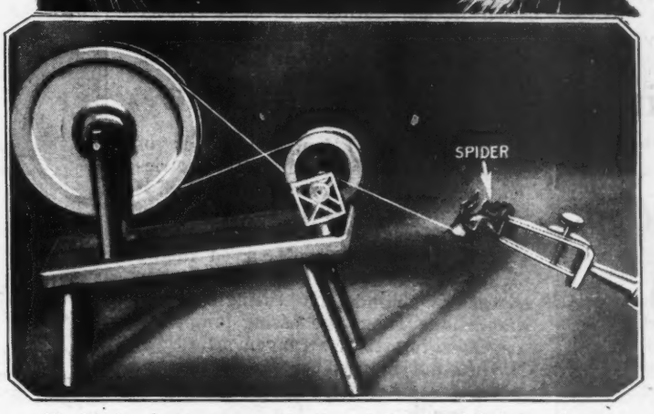
His speed interested me so much I determined to find out just how fast he could work. In order to do this I rigged up a minute spinning wheel that could be turned as fast as the spider could produce his silk. Waiting until the spider emitted a tiny strand, I fastened it to the spinning wheel and started turning the crank. The faster I turned the faster the spider worked, until he reached the speed of 280 feet of silk a minute. And two skeins of linen thread, about 600 yards in all, was once considered a good day's work for a human operator at a spinning wheel!

Then I watched bees building their

combs. Their work showed a perfection undreamed of by human efficiency experts. Each bee knew exactly what to do and did it without waste motion. Scientists will tell you that the bee, in building the cells in his comb, uses angles that employ to the best possible advantage the amount of wax he has to work with. No mathematician ever has been able to improve these angles. Who knows but what the bee understands mathematics that would baffle even Einstein?

The same holds for the common ant. Indeed, some scientists go so far as to place the ant next to man in intelligence. They point out the ant's ability to build homes, to keep farms, cattle, slaves, and cows to be milked; to make war in well organized battle formation; even to get drunk and dope itself with drugs.






The ferocious looking house spider above demonstrated that as a spinner of silk it is more proficient than man. The lower photograph shows the spider feeding a tiny spinning wheel at the rate of 280 feet of silk a minute!

## *Temperamental Insects*

While there is some doubt about any such intellectuality on the part of insects, there is no doubt they have one characteristic in common with mankind. That is temperament.

Human stars of the screen are proverbially capricious. It is somewhat of a distinction, then, for me to be able to claim that I am producing pictures with a company of players that for whims, wilfulness, disinclination to work, and general ability to exasperate the director has no equal in the many studios of the great motion-picture industry.

You probably have seen spiders in the act of eating flies. I know I have. But when I wanted to film one in the act, I found myself up against it. I offered my spider fly after fly, but he would not eat.

## *Spider Film Star Is Coy*

It took me nearly two weeks to coax him to eat. I believe he actually went hungry rather than do what I wanted him to do. And I spent nearly a week getting the spider to spin silk for me after I had built his spinning wheel. After the experiment was over, he built webs all over the studio.

As I said before, it took me three days to induce an ant to pick up a bit of matchwood, but when I threw such a stick into a hill of ants on which the camera was not focused, they fought to carry it off.

Of course, tiny creatures such as the members of my picture company cannot be set up and photographed as human actors or large animals can be. Special apparatus is required for the work, and, since suitable apparatus was not available, I had to develop it myself.

Probably the only part of my equipment that would be at all familiar to any one versed in motion-picture production is my camera. That is an ordinary studio model, although it is mounted on a permanent platform and the film is turned by an electric motor, somewhat after the fashion of the cameras used for making film titles. The rest of the apparatus is especially designed for my needs.

In ordinary photography—except in very close work—a variation of a few inches, or even a few feet, will not throw the subject badly out of focus. But when the subject is invisible to the eye and must be magnified thousands of times in order to be photographed, you can see that a movement measured in thousandth parts of an inch would be sufficient to destroy sharp focus. On this account it was necessary for me to develop a lens capable of 100 variations of focus within the thickness of a human hair. This may seem almost incredible. Consider, though, that in photographing the microscopic life in a drop of water confined between two glass plates, the distance between the two plates of glass is microscopically so great that the swimming organisms farthest away from the lens are actually out of focus!

## *Using Heatless Light*

Correct lighting, too, furnished a problem, for light from ordinary sources sufficient to illuminate my "scenes" contains enough heat to kill my actors. So it was necessary for me to develop a virtually heatless light. I do not claim, of course, to be the only inventor of heatless light, but my method is the only one that I have found satisfactory for microscopic motion photography.

I cannot claim to have made any discoveries in entomology as a result of my motion-picture work. But my camera has enabled me to bring to the eyes of every one the absorbing events of the kingdom of insects that heretofore scientists alone have been able to view.

## *Parasites in the Ant's Eye*

I have made one-reel pictures of the bee, spider, and ant; but so far have scratched only the surface. In studying the ants I found that in some cases they have parasites on their eyes, tiny organisms living in their own tiny world. Such revelations make me wonder whether there is any limit to the nicety of nature's work. First the tiny ant, then its smaller eye and then complicated little mites with eyes of their own living and dying in that eye! And who can say that science will not discover even smaller creatures living in the eyes of these parasites?

The lives of the insects are full of mystery, charm, and human appeal. No one will ever exhaust their interesting possibilities.

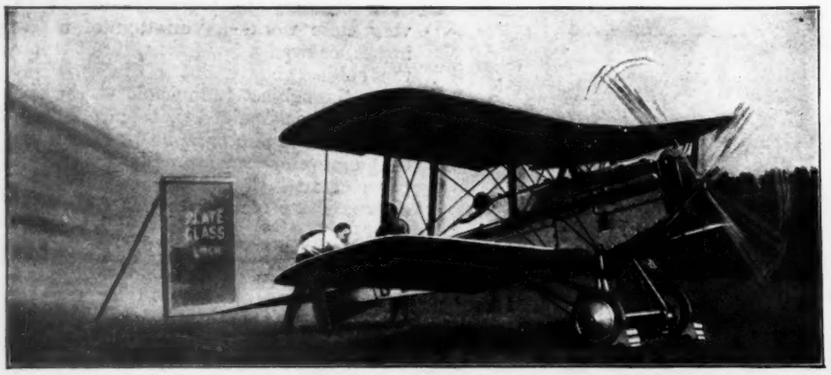
**THINK of an ant the size of a man and with the strength to lift 240,000 pounds and you have some comprehension of the fascinating interest which Mr. Tolhurst finds in his daily work.**

**Educated for the bar, this young California scientist has brought science to motion pictures and the wonders of insect life, hitherto to be observed only under microscopes, before the eyes of every one.**

**Read his story of the strange things seen in the world of the infinitely small. You wonder how man became the dominant creature in the world!**



Support with Rosin Keeps




# Plane Creates Gale to Test Glass

TESTING the resistance of plate glass by means of an artificial 125-mile gale created by the whirring propeller of a motionless airplane was the feat performed recently at the Curtiss Flying Field, Pine Valley, N. J. An SE-5 plane, equipped with a 220-horsepower motor, was used.

A sheet of plate glass five by six feet and one quarter inch thick was placed directly behind the tail of the machine in such a way that the blast developed by the propeller would be directed against it with the least possible diffusion. The glass showed no trace of injury after the test. The velocity of the gale was measured by calculations involving motor revolutions, propeller pitch, and slippage.

# A Disappearing Fan for the Home

The fan blades extended for use

AN ELECTRIC fan, the blades of which disappear into an electric-light chandelier when not in operation, is the invention of Clarence W. LeVelle of Wichita, Kans.

The fan is formed of curved blades pivotally attached to a rotating plate concealed behind the casing of the chandelier. From the casing lamps are suspended in artistic arrangement.

When not in use, the fan blades are swung back by spring controls into a concealed position.

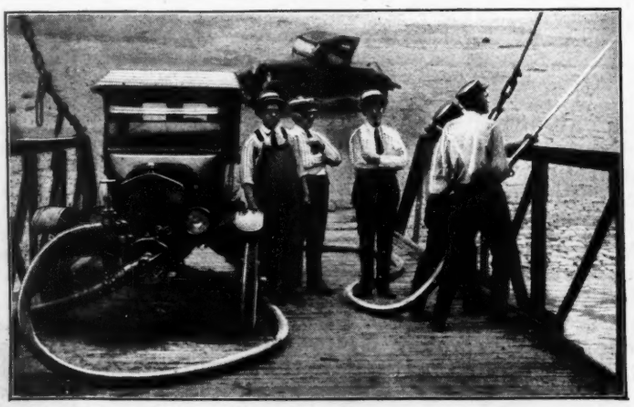
## Fingernails Grow 27 Yards

FROM a Swiss scientist comes an announcement that the average man of 50 has 27 yards of fingernails in his lifetime. He says that children's nails grow faster than those of adults; thumbnails faster than little fingernails.

# Fire Pump Driven by Ford Engine

A SMALL, portable pump attachment for Ford cars, driven by the automobile engine, recently has been perfected for use in construction and road work, fire protection, and irrigation.

When the engine is running at a speed of 18 miles an hour, the pump is said to have a capacity of discharging from 200 to 250 gallons of water a minute at a pressure of 20 pounds. It will lift water by suction to a height of 26 feet. The first installation of the pump and attachments requires about an hour and a half. Thereafter it may be connected or disconnected in two minutes.



An auto, with pump attachment, lifting a stream of water

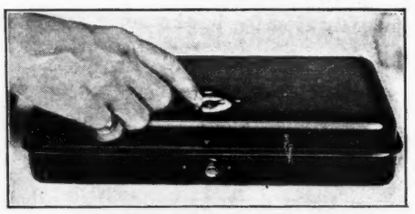
## Simple Spool Device Aids in Developing Photos

FACILITATING the work of the amateur or professional photographer, this simple film-developing device consists chiefly of two spools, mounted on spindles. Each spindle is attached to a vertical support, and the film to be developed is carried on the two spools.

Developing a roll of films held on spools

The upper spindle has a handle so that the film may be revolved. The vertical support is vertically adjustable, so that a film strip of any length can be accommodated. A semi-cylindrical basin just under the bottom spool contains the developer or other solutions, so that the revolving film passes through it.

Thus the operator can stand in a practically erect position while handling film.



## Family Strong Box Has Combination Lock

PRYING fingers cannot disturb valuable documents if they are locked in this fire- and burglar-proof safety box recently designed especially for family use by a manufacturer in Fulton, Ill.

The box has a special combination lock, with dial control.

## New Gum for Varnishes

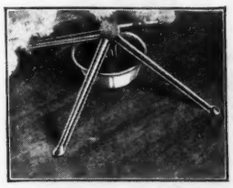
"CUAPINOLE" is a tree from which a new gum is taken in Mexico. It is reported to be of such quality that it may be used in making the finest varnishes.



# Twin Typewriters Decode Messages

## Support with Basin Keeps Christmas Tree Fresh

THIS Christmas-tree support fits any tree, preserves it from withering, and restricts its tendency to shed needles. It will hold a tree weighing 250 pounds, it is claimed.



The four legs of the device, spreading enough to allow a container of water to stand between them, raise the tree several inches from the floor. Thus, although the base of the tree extends into the water, it does not rest on the dish. This supply of water keeps the tree fresh.

A wingnut adjusts the holder to the size of the tree butt, and holds the tree securely. Screw holes in the legs permit fastening them to the tree.

When not in use, the holder folds into a small, compact shape.

The air-pressure rifle

## High-Pressure Air Rifle for Marksmen

ANY marksman can practise with a new high-pressure air rifle recently put on the market. It has the full range and penetration of a high-powered firearm. The rifle is 22 caliber and will kill all sorts of small game at 100 feet.

A plunger rod with a button that protrudes from the end of the gun, works back and forth in the gun barrel. Air is compressed in a chamber by placing the muzzle of the gun on the floor, holding the plunger rod button firmly between the soles of one's shoes, lifting the gun until the rod is out full length, and then bearing directly down. The number of strokes pumped in the gun determines the force of the shot.

Inexpensive pellets are used as ammunition. There is nothing in the gun to wear out and the only care necessary is an occasional oiling.

E. S. Wilson, government chemist, with 38 samples of bootleg liquor under test

# Peril in Bootleg Poison Revealed

TEN to one odds against the man who patronizes the bootlegger were revealed recently when 38 samples of illicitly sold liquor, bought in 15 cities, were analyzed by Government chemists at Washington, D. C.

Only two of the 38 proved to be whisky of pre-prohibition grade. One was purchased in Boston and one in Washington, D. C. Two were passable synthetic gin, from Cleveland and Los Angeles. The remaining 34 samples were poisonous.

## Portable Welding Outfit Carried like Knapsack

AN OXYHYDROGEN burning and welding apparatus that can be carried on the back of a workman like a knapsack has been invented in Germany. Heretofore it has been necessary to use two heavy steel tanks and long hose to convey the gases to places difficult of access. Sometimes the hose has been cut in confined spaces with serious results to the workmen.

The new outfit consists of two small steel tanks, one containing liquid oxygen; the other, liquid hydrogen. Pressure of the gases is controlled by valves. A third control regulates the mixture of the two gases for the flame.

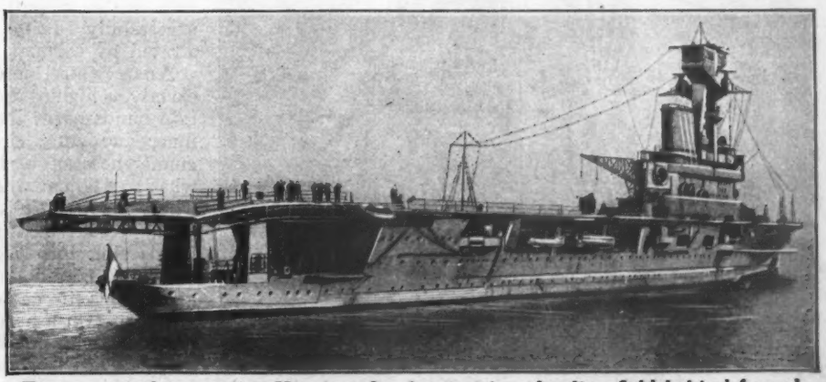
# England Has Speedy Plane Carrier

THE first vessel in the world especially designed as a floating landing field and airplane carrier, the *Hermes*, was put through protracted and comprehensive tests by the British Admiralty. The carrier is capable of a speed of 25 knots.

In the body of the *Hermes* are two hangars with room for 20 planes.

The funnel, observation tower, wireless apparatus, and operating quarters all are placed far up in the bow, allowing for a spacious flying deck extending more than three fourths the length of the vessel.

Planes are elevated from their hangars to the flying deck by electric lifts and cranes.

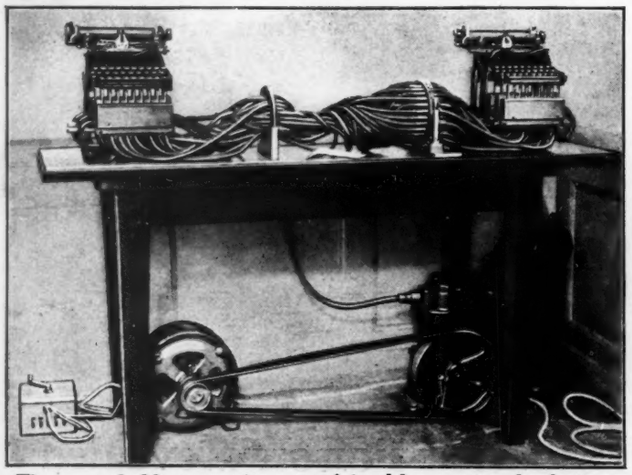


The new airplane carrier *Hermes*, showing spacious landing field behind funnel



## Umbrellas Tested by Wind

# Twin Typewriters Decode Messages



The remarkable typewriters are joined by a network of wires

BY A simple adjustment, a message typed on one of these typewriters can be made to appear on a sheet of paper in the opposite typewriter in any one of 280 codes.

Similarly, a message in any one of these 280 codes can, by the same sort of adjustment, be decoded on a sheet of paper in the other typewriter. The machines can be operated long distances apart.

## Twin Camera Takes Movies and Stills at Once

MOTION pictures and still pictures can be taken simultaneously, and focused by one finder with this Siamese-twin camera. Above is shown Frank S. Wilton, of Huntington Park, Calif., inventor of the camera, with which he photographed a large part of the film, "Hunting Big Game in Africa."

The motion picture part of the camera is fitted with four lenses, including a telephoto lens for taking close-ups of wild game.

# This Shaving Brush Will Soap Itself

WORKING on the principle of the fountain pen, this remarkable new fountain shaving brush can be filled with an ever-ready supply of shaving cream. When not in use the brush is inclosed in a removable cover that protects the bristles.

The brush may be regulated so that any desired quantity of soap or cream is forced into the bristles when required. This is accomplished by an ingenious plunger arrangement. This feature eliminates waste of shaving cream.

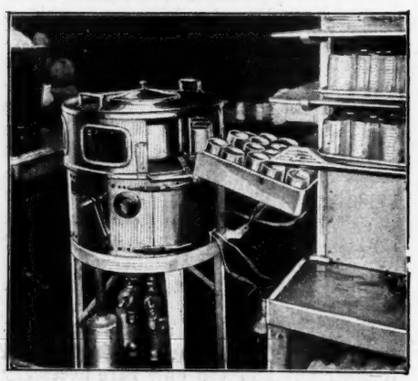
The brush reservoir holds enough shaving cream for more than 70 shaves. When the brush has been charged with shaving cream, the bristles are dipped into water and the soap solution is then worked up on the face as with the ordinary brush.

Filling the fountain brush. The parts are shown in inset

## Electric Machine Washes Glasses Automatically

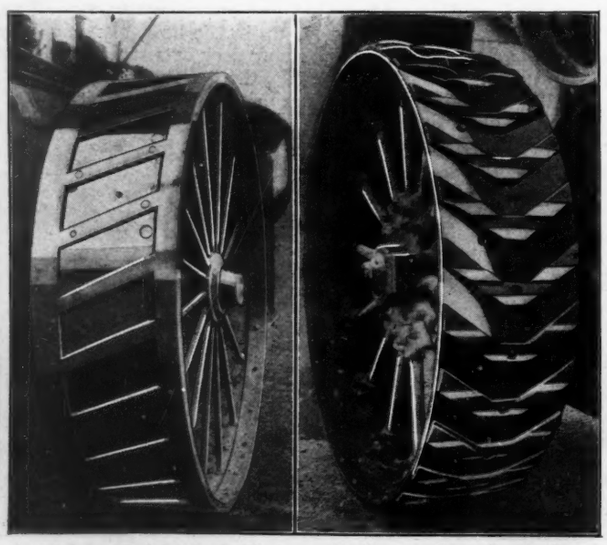
AN AUTOMATIC washing and sterilizing machine for glassware, for use in restaurants, is electrically operated. Its capacity is 700 glasses an hour.

The glasses are conveyed by a circular motion to a cold-water spray to remove refuse, then to a hot alkali wash for cleansing, then to another cold spray to remove excess alkali, then to a sterilizing solution that destroys bacteria, and finally to an electrically heated hot-water rinse that assists the drying. The glasses require no handling once they are placed on the tray of the sterilizer.



This machine washes 700 glasses hourly

# New Tractor Wheels Protect Roads



The new tractor wheel — Ordinary cleated wheel

A TRACTOR grip wheel, which is said not to injure roads, has been invented by Calvin and Nelson Davey, of South Vienna, Ohio, and was recently successfully demonstrated by them.

A narrow steel band exactly as high as the grip bands edges the inner and outer circumferences of each wheel. When the wheel operates in a field, these edging bands sink into the earth and permit the grip bands to come into use. On a hard road the edging bands keep the grip bands from making traction.

## Umbrellas Tested by Wind from Airplane Propeller

TO MAKE sure his umbrellas would not be turned inside out in any ordinary storm, an inventive umbrella manufacturer decided to subject them to airplane wind tests, which are the severest wind tests known.

An open umbrella, held before a seven-foot tunnel through which the wind was drawn by a 420-horsepower Liberty motor, withstood a wind strain of 34 miles an hour before collapsing.

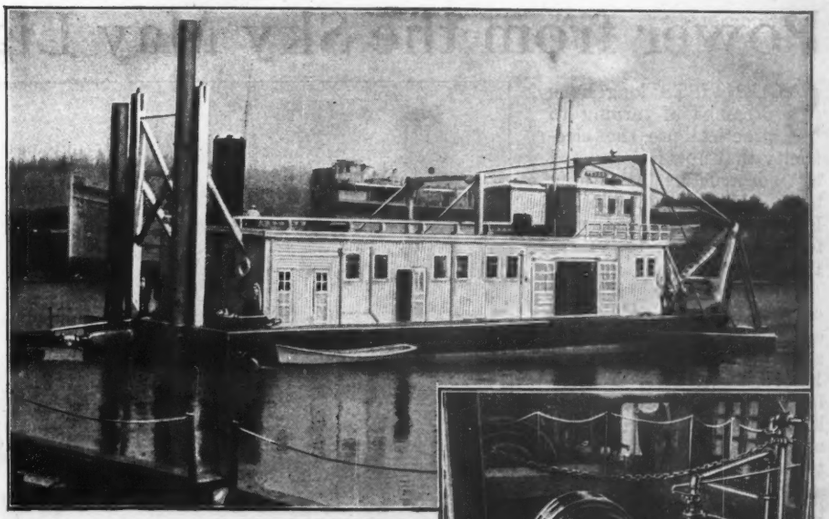
As the umbrella was subjected to the full force of the air current, it was stated that in actual use it might stand an even greater wind. At the velocity of 34 miles an hour the operator had difficulty in holding it. The manufacturer claims to have been able to develop the strongest umbrella known.

Testing an umbrella in wind tube

## "Murder-Tree" from Brazil

A VERITABLE "murder tree" called clusia—an ogre from the tropical forests of Brazil—is a new attraction at Kew Gardens, London, England. With aerial roots it strangles every tree near.

Birds deposit the clusia seeds on branches of neighboring trees. From the seed, roots grow toward earth, throwing out branches that envelop their victim.



The river dredge and its Diesel engine

## First Diesel-Electric Dredge Economizes Fuel

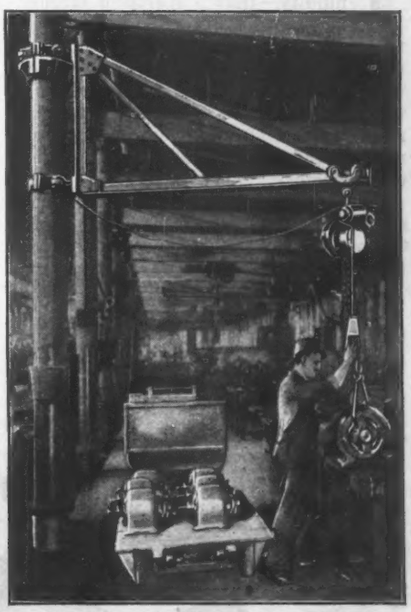
LESS than half the normal amount of fuel is said to be necessary for the operation of a new dredge at work in the Columbia River at Longview, Wash.—the first pipe-line dredge in the world to be operated by Diesel-electric power.

Fifteen barrels of fuel oil are required in 24 hours to operate the 525-horsepower Diesel engine, which in turn runs an electric generator to drive the electric machinery of the dredge. A steam-power dredge of approximately the same power and capacity requires 40 barrels of oil a day for her furnaces. At present prices this is said to represent a saving of more than $50 a day.

The dredge was designed specially for shallow digging by James H. Polhemus, general manager and chief engineer of the port of Portland, Ore. It is capable of moving 225 yards of material through a 15-inch pipe-line in an hour. It is the smallest of a number of dredges engaged on a lumber mill and town site project, in which more than 12,000,000 yards of material will be moved. On such a huge project the saving that the Diesel-electric engine is said to effect will be considerable.

## Portable Electric Hoist Saves Manual Labor

A PORTABLE and easily operated electric hoist, that permits one man to do the work of several, has been perfected by a Philadelphia concern for shops and factories where bulky materials and machinery must be moved quickly and often.



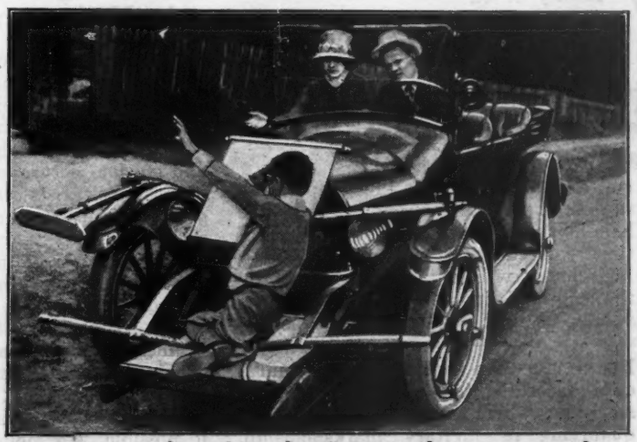
Hoist is controlled with one hand

The device consists of a standardized chain hoist of steel, electrified by a heavy-duty motor, which may be adapted also to standard chain hoists already in service. A hanging controller is operated by one hand, leaving the other hand free to guide the load.

Where current is not available, or if the power fails, the hoist may be operated by hand as an ordinary block.

# Safety Bumper Has Canvas Stretchers

INJURY to a pedestrian struck by an auto equipped with this automatic safety bumper is practically impossible. Contact with the pliable front guard rail of the automobile causes two arms to spring out and draw the person struck on to two canvas stretchers, so designed as to prevent sharp contact with any part of the car.

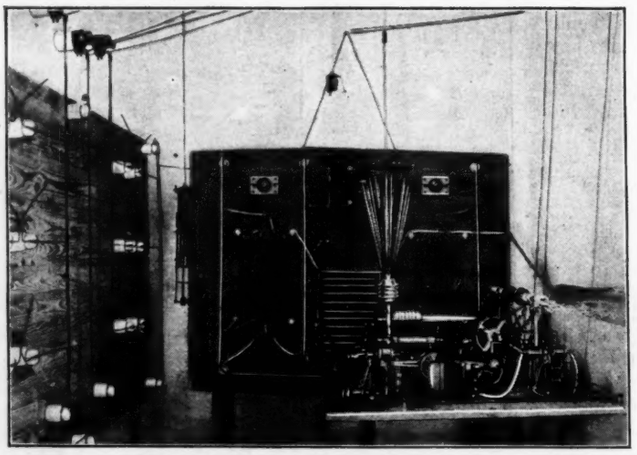


Bumper arms draw the pedestrian onto the canvas stretchers

# Power from the Sky May Light Our Homes

SCIENTISTS long have dreamed of turning to practical use the electricity that now is consumed by destructive lightning bolts. M. Jules Guillot, a French inventor, has perfected a machine to utilize this latent power.

He bases his experiments on the theories of static electricity proved by such scientists as Franklin, Lord Kelvin, and others. According to these theories, static is produced by the motion of the earth around its axis through the non-conducting ether. This motion causes the earth itself to become charged negatively, while the air around it is charged both negatively and positively.



The complicated apparatus used by M. Jules Guillot at the summit of Mont Blanc, Switzerland, to draw power from the air

Since like charges repel each other and unlike charges attract each other, the atmosphere's negative charges are thrown away from the earth's surface while the atmosphere remains as a positively charged blanket.

The difference of potential between the positively charged air and the negatively charged earth constitutes an unused source of electric energy. Since the amount of this difference depends on the distance from the earth of gas particles forming the atmosphere, Guillot has established his experiment station upon the summit of Mont Blanc in Switzerland.

At the station there are two antennae, one extending toward the equator, the region of maximum density of the positive charges; the other consisting of a number of iron points extending vertically upward. The positive ions are attracted by the antennae pointing south and build up a charge upon a plate in the machine. A second plate is connected with the vertical antennae. Because of the difference of potential, this second plate absorbs a certain amount of negative ions that ordinarily would be repelled from the earth. Thus it is possible to establish a difference of potential or voltage within the machine that will cause a current to flow from one to the other when they are short circuited.

Instead of trying to use the voltage for this purpose directly, the charges are led off through step-down transformers.

It is claimed by the inventor that in this way he has been able to keep ten 50-watt lamps burning, utilizing only the static electricity of the air.

# Measuring Flowing Quality of Oil

THE measurement of viscosity, or fluidity—that property of lubricating oils having to do with their resistance to flow—always has been a troublesome one to engineers. The most widely used instruments for measuring viscosity have been suited only to laboratory use and the involved computations necessitated have made them highly unsatisfactory.

Now, however, comes an extremely simple instrument that is said to determine fluidity far more accurately than any device so far invented. It consists of a cup of steel or cast iron, provided with a hollow stem that forms a thermometer pocket extending into the metal of the cup. A steel ball fits into the cup. The concave surface of the cup has three minute projections that prevent the ball from making complete contact and also regulates the thickness of the film of fluid under test.

In taking a measurement of the fluidity of an oil, the steel ball is dropped into the oil and picked up by pressing the cup on it. Fluidity at the temperature registered by the thermometer in the handle is determined by the length of time required by the ball to fall.

Formerly viscosity was measured by the length of time required by a certain volume of oil to flow through a tube.

The time it takes for the oiled ball to fall from the cup measures fluidity of oil

The new measuring outfit

BLUE-EYED men make the most bull's-eyes, according to United States Army statistics, which show that of 1000 men qualifying in military marksmanship, 605.41 have blue eyes and 394.59 brown.

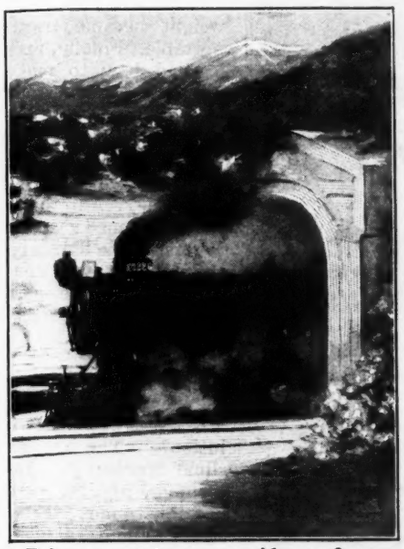
## He Studies Microscopic Life in Yellowstone Geysers

THE sort of life that may have swarmed in primordial seas is being studied in the hot springs and geysers of Yellowstone Park with an extraordinary combination of high-power microscope and motion-picture camera.

Most scientists believe that, when geologic time was young, the earth's crust and its waters were extremely warm. They believe that only special forms of life could exist in those ancient seas. The present studies, under the supervision of Dr. R. B. Harvey of the University of Minnesota, shown above, seek to determine whether the microscopic creatures in Yellowstone's hot waters are similar to those ancient creatures, and to learn, if possible, the biologic secret of their heat endurance.

## Engine Crews Endangered by Gas in Tunnels

AN ARTICLE in the September issue of POPULAR SCIENCE MONTHLY called attention to the danger to public health in carbon monoxid gas from the exhaust pipes of automobiles. Now the Department of the Interior, after an extensive investigation, has reported another grave menace—the possible asphyxiation of locomotive crews by the same poisonous gas from the engine stacks while passing through long tunnels.



Poisonous carbon monoxid gas from engine stacks endanger the crews

The most satisfactory solution of the problem, according to experts, is to supply air to the engine crew through respirators attached to the air-brake pipe line of the train. These respirators consist of funnels connected with the pipe lines by rubber tubes and held by members of the engine crew near their faces. Valves controlled from the engine cab regulate the flow of air for normal breathing. The pipe lines supply pure air for 30 minutes.

# U. S. Has School for Hay Inspectors

A TRAINING school for Federal hay inspectors, the only institution of its sort in the world, has been opened in Auburn, N. Y., under the direction of the U. S. Department of Agriculture.

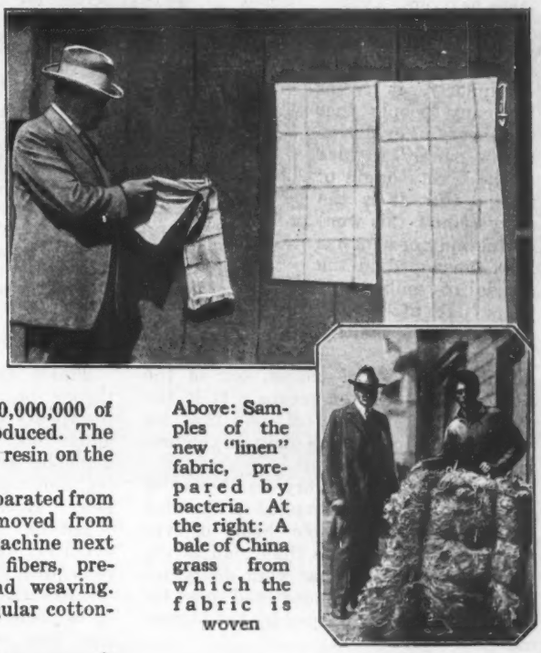
Completing their training, these inspectors are distributed throughout the hay producing sections of the country, to issue certificates upon hay that meets Federal standards. The men are shown above at work in the school grading hay according to the government standard.

## Grass Fabric Made by Bacteria

WITH bacteria for assistants, Jonas Brolin, a textile engineer of Oakland, Calif., is said to have manufactured a fabric as fine as linen from China grass. The new cloth is said to cost far less than those for which it is a substitute.

The grass is soaked in tanks of water over which are spread bacteria that reproduce with astonishing rapidity. A cubic inch of water is said to contain 2,000,000,000 of them soon after they are introduced. The bacteria attack the gum and resin on the grass fiber.

When the gum has been separated from the fibers, the grass is removed from the tanks and dried. A machine next softens and subdivides the fibers, preparatory to the spinning and weaving. These final processes use regular cotton-manufacturing machinery.



Above: Samples of the new "linen" fabric, prepared by bacteria. At the right: A bale of China grass from which the fabric is woven

## Electrical Bath Cure

ELECTRIC baths are made possible by a novel electro-therapeutic apparatus developed by two physicians of Newark, N. J. The patient is placed within a magnetic field in a cabinet, where he may be sweated, baked, or bathed with electric light, according to the treatment his ailment requires. At no time is he in contact with a primary electric circuit, as only induced current is used.

## Snowflakes as Patterns

LOOK at your necktie and see if it has an unusual design. Perhaps that design was suggested by a snowflake.

"Snowflakes are used by silk manufacturers extensively as patterns," says Wilson A. Bentley, speaking of his article for next month's POPULAR SCIENCE MONTHLY. "Jewelers fashion delicate designs from ideas they get from snowflakes. Even biscuit makers transfer Nature's handiwork to their cookies."

Mr. Bentley's is a remarkable story of a farmer whose fascinating hobby made him famous. It is full of the wonder and romance of science.

# Evolution—A Universal Law

## *Concluding Article in "The Story of Man and His World"*

**By E. E. Free, Ph.D.**

THE subject of evolution is like this round ball that we live on and call the earth—it is so vast that no man can see more than a little of it at once.

To any single human eye the earth seems nothing but a broad, flat plain more or less wrinkled with mountains and scratched here and there with lakes or rivers.

### *A Limited View*

Similarly, it seems to many people that the theory of evolution means merely an idea of the bodily origin of man; that it is the story of how this wonderful body of ours has been developed in the course of millions of years out of simpler and more primitive kinds of creatures.

HOW INVENTIONS EVOLVE

The first typewriter of 50 years ago would be unrecognizable today. The telephone, the dictation phonograph, the bookkeeping machine and other results of scientific evolution have transformed the modern office

This really is, of course, *one* of the things that evolution means. It is the story of the evolution of man that we have been telling, in the main, in the previous chapters of this serial.

But this is only a very small part of what is included and implied in the idea of evolution. The whole theory of evolution is as much more than man as the whole earth is more than your dooryard. It is probably the grandest and most far reaching idea ever grasped by the human mind.

The idea of evolution may be defined, as I have explained in a previous chapter, as the idea of change. Things alter as time goes on and become new things. The unending panorama of growth and alteration is the universal law of life.

### *All Things Change Continually*

Unliving as well as living things change. The earth changes. Mountains are worn down. Rivers alter their courses. The oceans advance and retreat. Ice sheets spread and disappear. The eternal hills are not eternal. The fixed stars are not fixed. Everything in the universe—man and man's ideas, the world he lives on, the sun that warms him, the stars that he looks up to and wonders at in the sky, even the chemical elements that make up the machine that man calls his body; each and every one is in continual change. "Permanent" things seem permanent to us only because we live so short a time. If a lifetime were a billion years, we should see the mountains melting before our eyes, the stars racing across the sky, the earth heaving and wrinkling under us.

This is the greater theory of evolution, the theory that not man alone, nor living matter alone, but *everything* is changing, moving, producing something new. Everything everywhere evolves.

Let us take a familiar example—the evolution of inventions. Many people remember the first telephones; a few remember the first typewriters; nearly all of us remember the first automobiles or the first airplane, with the Wright Brothers riding out in front of it on a little board, like some one perched precariously on a window-sill. Compare these recollections with present-day realities. Inventions, machines, human devices of all kinds obey the universal law. Not even so simple and satisfactory a thing as the buttons on your coat remain the same for 10 years in succession. This is evolution.

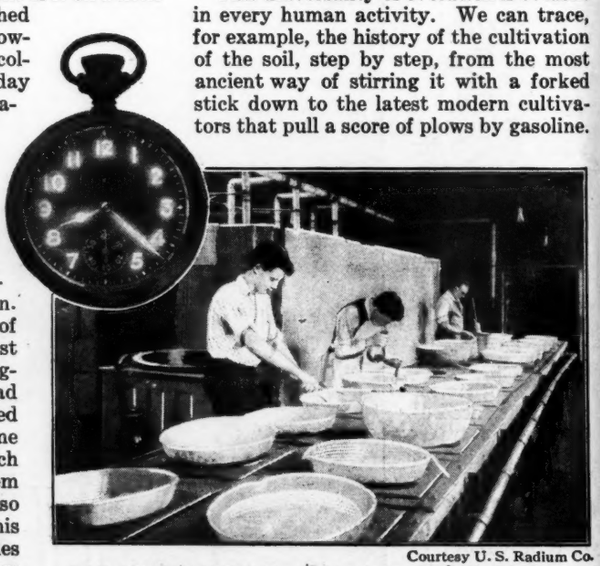
Think of the history of transportation. The first men were their own wagons; when something had to be moved, they carried it themselves. Then some one learned how to catch wild oxen and make them into beasts of burden so that one man, using his brain to direct the muscles of his ox, could carry more weight and could take it farther in a day. Soon some other genius invented a drag of poles to slide along behind the ox and still more weight became transportable. Finally, men learned how to make wheels and wagons that rested on them and how to catch horses that could move faster than oxen and go farther in a day. And today we have tamed gasoline to replace the horses on the highways and steam to transport things still longer distances over rails.

### *Life's Inventions*

What is this but evolution? The ancient slime specks, you remember, at first were not able to move themselves about at all. Then presently they invented muscle fibers so that they could twist themselves through the water. Next they invented a stiff rod down the back so that the muscles could twist them more violently and move them faster. They then began to swim like a fish. Gradually, invention by invention, they moved ashore and learned to creep and to walk. Some of them have even learned to fly.

How similar this is to the history of the human inventions that have given us our present means of transportation.

This universality of evolution is evident in every human activity. We can trace, for example, the history of the cultivation of the soil, step by step, from the most ancient way of stirring it with a forked stick down to the latest modern cultivators that pull a score of plows by gasoline.



Courtesy U. S. Radium Co.

RADIUM EVOLVES—How radium is prepared for many uses, including illumination of familiar radium watch figures (inset)



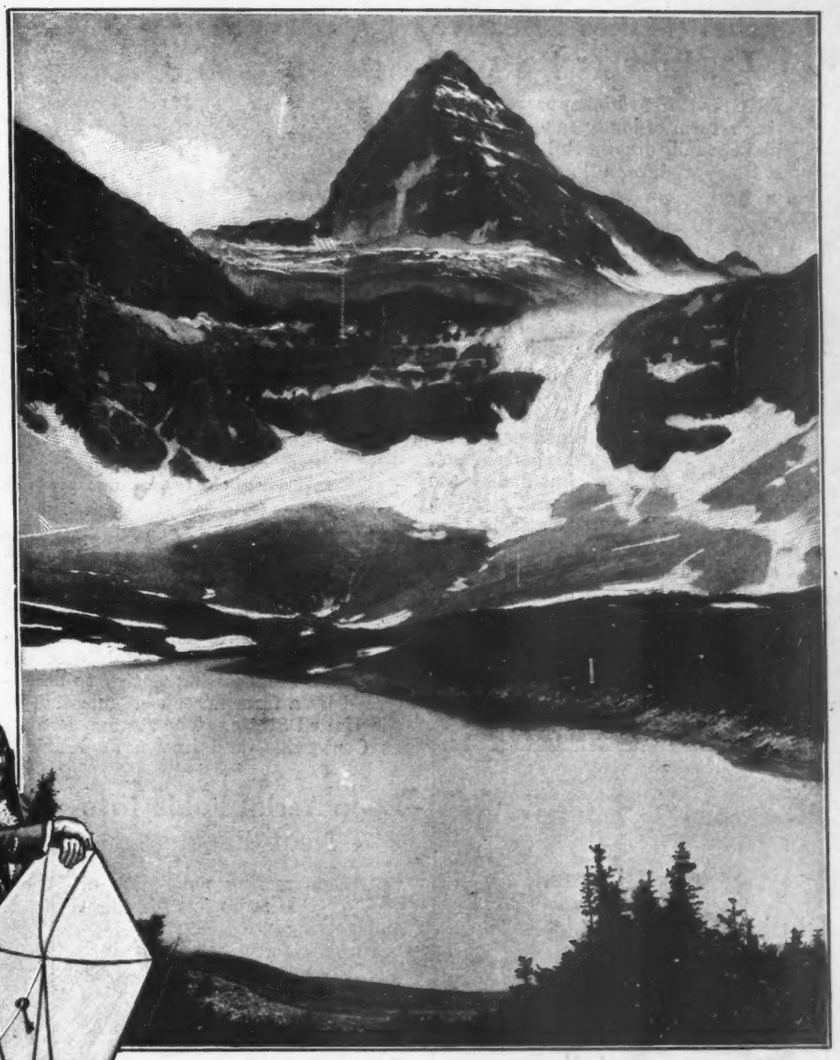
**Seashell Makes Effective**

We can trace weapons of warfare in unbroken sequence from the hurled stone or swung club of the caveman to the poison gas and airplane bombs of modern destructive science. Even cookery is a traceable evolution from the ancient hot stone dropped into the stew with the bones. Fountain pens and fluid ink are direct descendants of the earth-smeared thumb of the prehistoric cave painter. We still have two buttons on the backs of evening coats because men used to wear a sword belt that had to be held up behind; an evolutionary vestige this, quite comparable with the fact that we still have an appendix inside the human body.

## *Ideas Are Subject to Change*

Nor is invention the only place where evolution is evident. Ideas, too, are subject to evolutionary change. Think, for example, of what men believed from age to age about the place and support of the earth in space. In the beginning they thought it was a flat thing like a saucer floating in a universal sea of water. A few people, more curious or imaginative than the rest, asked themselves what the water was resting on and found no answer except the mythical ones of a great elephant or a broadbacked turtle or some gigantic strong man like Atlas. On some creature like this the whole universe that we know was supposed to rest.

But as time went on, these ideas changed. Men perceived that the earth was really a round ball, the center of the universe. The heavens revolved around it. Then ideas changed again. We believe now that the earth, far from being the center and focus of everything, is but a tiny speck revolving around a mighty sun which is itself a mere speck in the inconceivable vastness of space. And that the evolution of these ideas is still going on, that what we think about space and about the nature of the universe is about to change again, is evidenced by the theories of Professor Einstein with which the scientists are now so much concerned.

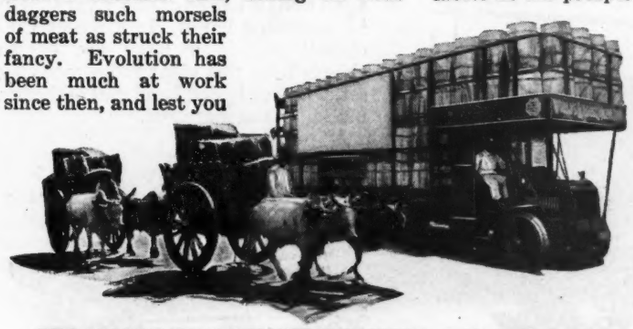


IF YOU COULD LIVE A MILLION YEARS you would see this mountain melt away under the rains and snows of the centuries. Not only the very earth itself, but our uses of its natural forces, are in evolution. Compare the modern wonders of electricity with Benjamin Franklin's kite that pulled electricity from the clouds, paving the way for a new age of scientific marvels

Other examples of the evolution of ideas are visible in those that we call social customs. Consider table manners, for example. The cave man merely grabbed what he wanted, dipping his hairy fingers in the pot or snatching bones out of the fire. Even so recently as three or four centuries ago most of our ancestors ate from a common dish, slicing off with daggers such morsels of meat as struck their fancy. Evolution has been much at work since then, and lest you think these matters of social custom unimportant in world history, remember that few crimes are punished so unfailingly or promptly, either by business or by society, as crimes against custom, the crimes, for example, of guzzling coffee from a saucer or of eating with your knife.

It is not in the least an exaggeration to say that if one is unable to acquire such table manners as one's social surroundings demand, this may be an even larger factor in the prosperity of the individual and in the survival of his offspring than was a weak backbone to a creature in the stage of evolution between the worm and fish or an unsure eye to the monkey who was on the way toward an ape.

It is quite possible that the scientists of 10,000 or 20,000 years from now, when they come to look back on the 10 centuries of the millennium in which we are now living, will hold its most important evolutionary event to have been the growth of those social ideas and customs that scientifically we describe as humanitarianism but which find their real and everyday expression in what we call politeness. (*Continued on page 140*)



THE EVOLUTION OF TRANSPORTATION is strikingly illustrated by this comparison of the ancient ox cart with the modern motor truck

*Beginning Next Month*

**The Story of the Mind**

*Most fascinating and useful psychological series ever published in a magazine*

**By James J. Walsh, M.D.**

*Famous American surgeon and psychologist*

**Read his preface on page 34 of this issue**

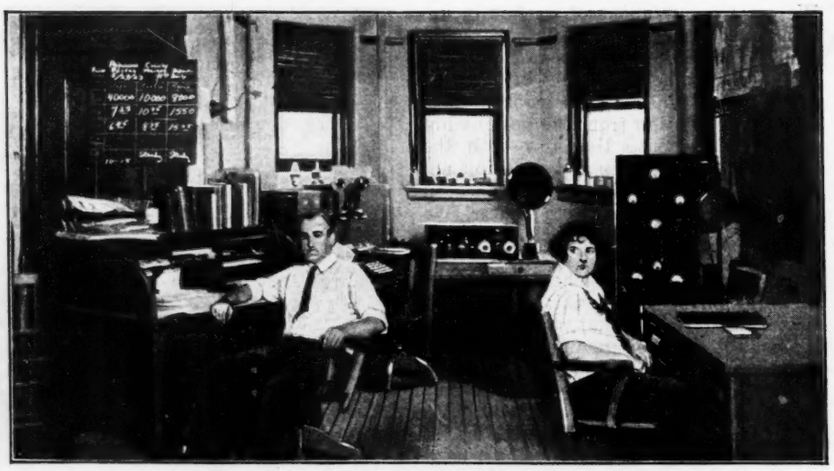


# Tuning Coils—the Nerve Centers

## Seashell Makes Effective Loudspeaker Horn

DESIGNERS of radio apparatus, seeking a form of loudspeaker horn that would be small, ornamental, and at the same time produce a large volume of sound, are said to have received valuable suggestions from the accidental use of a seashell as a horn by a radio enthusiast in Atlantic City, N. J.

Desiring a loudspeaker for his portable set, but finding the horn too bulky, he attached the shell to the loudspeaking telephone and was astonished by the result. Although the shell was only a few inches long, its peculiar shape gave it acoustic properties that caused it to produce as loud and perfect tones as had been obtained from a larger horn.

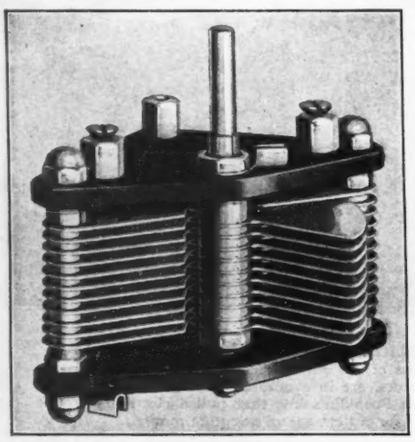


**Interior of the farm bureau radio broadcasting station at Centerville, Ia.**

# Farmers Own Broadcasting Station

FINDING the mails and the telephone too slow in distributing daily market information, progressive farmers of Appanoose County, Ia., have established the first radio broadcasting station to be operated by a farm bureau organization in the United States. The station, located at Centerville, and known as XYZ, is equipped with broadcasting and receiving sets of the latest type.

More than 100 farmers' receiving sets in the county listen each noon to market figures, news, descriptions of new farm methods and entertainment. C. W. Clarke, county agent, reports the innovation an unqualified success.

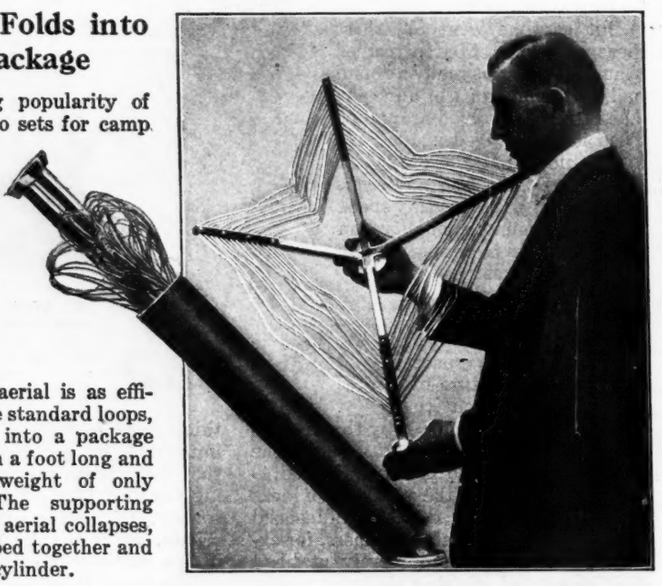


## Remedies Inaccuracies of Variable Condenser

THE inaccuracy in the spacing of the plates common to many of the present forms of variable condensers has been remedied by one manufacturer by making the spacing collars of the condensers an integral part of the condenser plates. By this form of construction accurate assembly and rigidity are assured.

## Loop Aerial Folds into Neat Package

THE increasing popularity of portable radio sets for camp and touring use has brought forth many types of portable aerials. The most satisfactory of these is the loop aerial type that can be folded into a compact package.



Although this aerial is as efficient as any of the standard loops, it can be folded into a package slightly more than a foot long and having a total weight of only 2½ pounds. The supporting frame of the loop aerial collapses, the wires are looped together and all inserted in a cylinder.

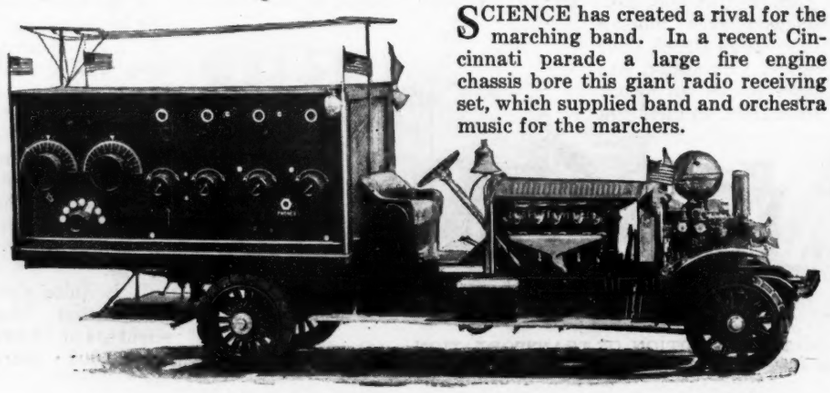
## How to Avoid Grounding of Your Aerial

BEFORE you try your radio set, make sure that there is no chance of any part of your aerial being grounded by touching or swinging against any grounded object.

When no signals are received, the trouble may be due to the fact that the wire leading from the aerial to the set is touching the wire going from the set to the ground. To eliminate this trouble, use insulated wires for leads to and from the set.

# Truck Carries Radio Band in Parade

SCIENCE has created a rival for the marching band. In a recent Cincinnati parade a large fire engine chassis bore this giant radio receiving set, which supplied band and orchestra music for the marchers.



# Tuning Coils—the Nerve Centers of Radio Reception

## *Various Forms of Inductance and Their Advantages*

**By Jack Binns**
*Radio Editor of POPULAR SCIENCE MONTHLY*

THE most important rule for the radio fan to learn in building his own set is that in the reception of broadcast wave lengths inductance is more important than capacity. Since inductance is obtained from coils of wire, and capacity from condensers, it follows that he will have to use as much of his coil and as little of his condenser as possible.

For that reason I am devoting this month's article to a consideration of various forms of inductances and their uses in radio circuits.

### *Many Coil Types*

The different types of coil in use are almost too numerous to mention in detail. Among them undoubtedly are still many of the old-fashioned single and double slide tuners. These invariably consist of a coil of enameled wire wound upon a tube of very large diameter. As a rule a brass rod is fastened above this coil, and a brass slider so arranged that it will run along the rod from one end of the coil to the other, making contact with the coil wire along a strip where the insulation has been scraped away.

With such a coil simple vacuum tube circuits can be made without the use of a condenser, because in the inefficiently wound coil itself is considerable distributed capacity. The simplicity of this form of coil makes it an ideal one for the beginner. Its disadvantages include its excessive amount of distributed capacity and the general inefficiency of the winding and contacting.

The simplest form of circuit with such a tuner can be made by joining the aerial to the active end of the coil, and a ground wire to the slider. The vacuum tube will be joined to an A and B battery in the usual manner. A wire should be carried from the aerial side of the tuner to the grid condenser, and another wire from the positive side of the A battery to the ground terminal. Tuning then is accomplished by running the slider up and down the coil until the required number of turns are obtained.

A variation of this form of tuner is a similar coil with two sliders attached, as shown in Fig. 1. The addition of the second slider converts the coil into an auto transformer, making possible the construction of a double circuit. The connections in this case will be the same as above, with one exception. Instead of carrying the lead from the positive side of the A battery to the ground, it will go to the second slider. Such a coil allows slightly greater selectivity than the single slide tuner.

ACCOMPANYING RADIO

Using her piano wires as an aerial, Miss Frances Mayer, of New York City, easily brings in broadcasted radio music which she accompanies on her piano. Careful tuning of her radio set and skill as a pianist are required for this unusual feat

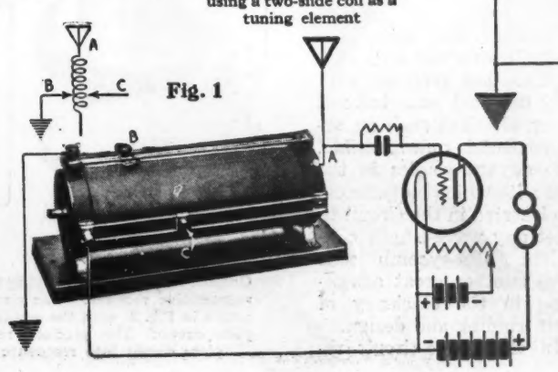



Fig. 1

The wiring diagram in Fig. 1 (below) shows one of the most elementary forms of a conductively coupled double-circuit vacuum tube receiver, using a two-slide coil as a tuning element

### *Slide or Switch*

In these tuners the brass slide takes the place of the switch in the variocoupler. The object is to bring into action a definite number of turns of wire.

Probably the most efficient instrument ever devised for varying inductance is the variometer.

The advantage of the variometer lies in the fact that it affords a means of continuously varying inductance without any of the losses that affect other coils, such as "dead-end" losses, or capacity effects in leads to switch points. The simplest possible connections can be made to it, and these can be extremely short, a very valuable factor in vacuum tube circuits.

It will give excellent results, for example, if it is connected between an aerial and ground, as shown in Fig. 2, with a vacuum tube connected with it in the manner I have described for the single slide tuning coil.

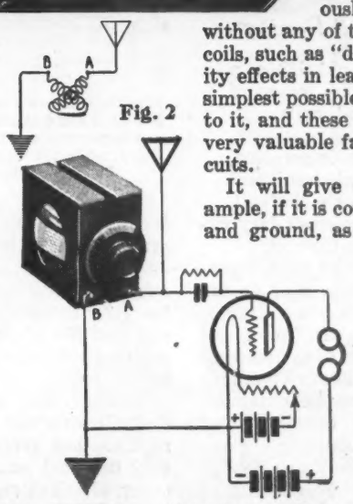



Fig. 2

Above is shown the same type of circuit as in Fig. 1, with a variometer substituted for the two-slide tuning coil. The variometer supplies a continuously variable inductance adjustable within small limits, thereby increasing the efficiency of the set

For fine tuning of inductance, the variometer cannot be surpassed. Its disadvantages are the difficulty of winding it and the limitations of inductance changing range. In constructing the instrument, shellac never should be used to bind the coils in place, nor should the wire be wound on heavy formers. A fairly efficient variometer can be made with two honeycomb or duolateral coils con-

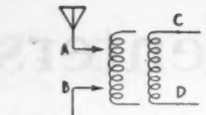



Figure 3 shows the most elementary type of inductively coupled double-circuit hook-up in which a vario coupler is used as the tuning element. Variable condensers can be added in both the primary and secondary circuits to increase the efficiency

Fig. 3

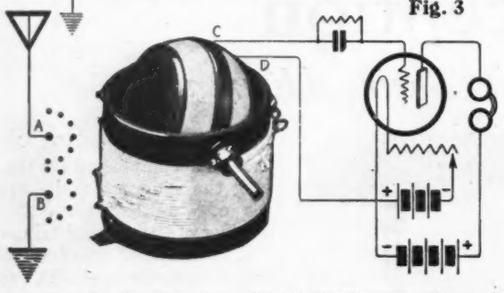
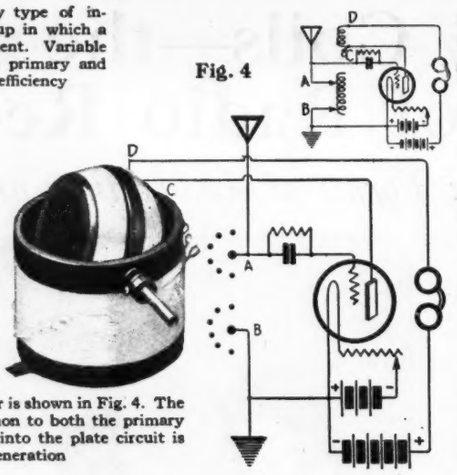



Fig. 4




An elementary type of single-circuit regenerative receiver is shown in Fig. 4. The stator coil of the variocoupler is used as the coil common to both the primary and secondary circuits, while the rotor coil connected into the plate circuit is used as the tickler coil to provide regeneration

nected in series on a two-coil mount. Varying the coupling between two such coils will give a variometer effect.

As soon as the radio fan has mastered the single circuit, he will desire to proceed to a more selective receiver, which probably will be by means of a variocoupler. In simple double circuits, such as that shown in Fig. 3, where no condenser is used in the aerial circuit, it is imperative that two sets of switches be used, one for single turns, the other for groups of 10 turns.

With the variocoupler, much of the tuning is done by varying the coupling between the rotor and stator coils. It will be observed that in every case the inductance of the rotor coil is fixed so far as the number of turns of wire is concerned. In the case of the simple double circuit a variable condenser should be joined across the rotor coil in order to get the full amount of efficiency. In tuning, the smallest possible amount of the capacity of the condenser, consistent with good results, should be used.

## *Another Double Circuit Receiver*

Another method of obtaining a double circuit receiver is by means of honeycomb or duolateral coils. In this case a two-coil mount is necessary, and two condensers are imperative. The condenser in the aerial circuit will be connected in series with the coil, while the condenser in the secondary circuit will be shunted across the coil.

The results to be obtained from regeneration are so advantageous that no fan will be content long to operate a straight non-regenerative receiver. In the case of regeneration, inductance is of extreme importance. There are two effective methods by which regeneration can be obtained; first by electromagnetic coupling, and second by electrostatic coupling. Electromagnetic coupling is the most efficient and the most practical. It consists of feed-back action obtained through some form of coupled coils. Electrostatic coupling is obtained from capacity feedback. To a certain extent, it can be obtained by the simple process of joining a variable condenser across the grid and plate terminals of the vacuum tube.

The simplest form of efficient regenerative circuit yet developed employs a variocoupler, as in Fig. 4, in such manner that the rotor coil acts as the feed-back agency. In this case the tube can be set into a state of oscillation by increasing the degree of coupling between the two coils, provided the rotor has sufficient inductance in its turns.

The outside (or stator) coil of the variocoupler is connected with the aerial and ground in the manner described for the circuit shown in Fig. 3. The grid circuit

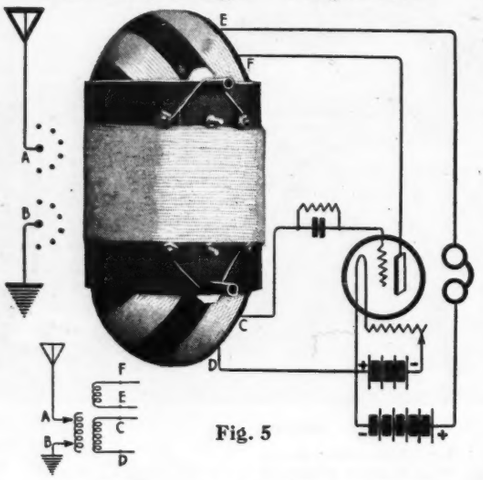



Fig. 5

Here the actions and qualities of the circuits shown in Figs. 3 and 4 above are combined. The stator and lower rotor coil produce the circuit shown in Fig. 3, while the regenerative action described in Fig. 4 is produced by the upper rotor

is connected with aerial and ground at both the switches, as in Fig. 4. The plate circuit runs from the plate of the tube through the rotor coil and the phones to the positive side of the B battery.

To many fans using honeycomb coils the idea of a regenerative receiver with only two such coils has not occurred. Yet such an arrangement is quite feasible. The advantage lies in the ease with which inductances are inserted in the circuit to meet any wave-length condition. Honeycomb coils have another great advantage, in the efficiency of their winding and design.

In the single-circuit regenerative set using the variocoupler, or in one using honeycomb coils, it may be necessary to reverse the connections with the tickler coil in order to get good results.

A variation of the variocoupler is a coil arrangement, somewhat resembling it, but with two rotor coils inside the outer tube, as shown in Fig. 5. Such an instrument permits the use of a double circuit receiver with regeneration. One of the rotors can be used as the secondary coil; the other as the tickler coil for regeneration. In this case it is best to connect a variable condenser across the secondary coil. The condenser should be of as small a capacity as is practical.

Now we come to a method of obtaining regeneration that has found great favor with radio fans, and one that is very efficient on short wave reception—the so-called "tuned plate circuit." This circuit takes advantage of the internal capacity of the tube.

It has two main forms. One consists of a variocoupler with a condenser joined across its secondary, and a variometer in the plate circuit. The other has a variocoupler with a variometer in series with its secondary and another variometer in the plate circuit.

## *Three Tuned Circuits*

In either form there are really three tuned circuits, each of which is placed in a condition of resonance with the incoming wave. The feed-back of energy between the plate and grid circuits is obtained from the capacity coupling existing between the grid and plate inside the tube.

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*IN NEXT month's article Jack Binns will tell of important new developments in the super-heterodyne receiver, popularly known as the "Rolls-Royce of radio."*

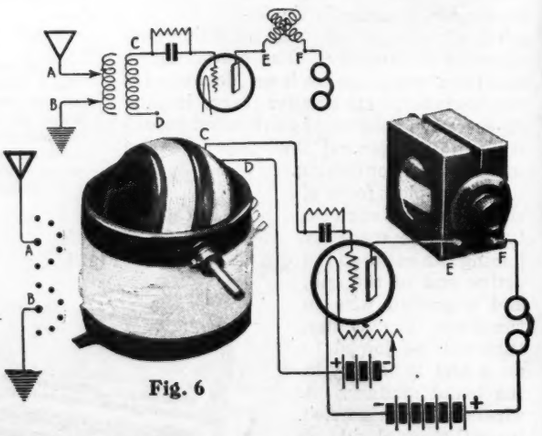



Fig. 6

Original form of the Armstrong tuned plate circuit type of regenerative receiver. The circuit is the same as that shown in Fig. 3, with the addition of a variometer in the plate circuit. This produces regeneration by tuning the plate circuit into resonance with the grid circuit

# Odd Ways to Make a Living

Colored feathers are tied to a fishhook to imitate a living fly. Much skill is required to select and shape the feathers

**LIFELIKE FLIES,** with steel fish hooks for backbones, are created with astonishing skill by Mr. and Mrs. J. H. Hornfeldt, of Ridgewood, N. J. They are shown above in their workshop, fashioning feathers to supply expert anglers with the indispensable lures

**AN ARTIST IN GLASS** is Herman Miller, who makes lifelike glass models of strange undersea animals for the American Museum of Natural History in New York. He is shown above inserting minute glass feelers in rotifers. By these feelers or suckers, the strange, leechlike creatures attach themselves to marine plants

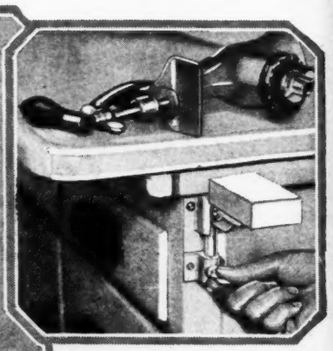
**CROWS AND BLACKBIRDS ARE DOOMED** at the Experimental Farm of the U. S. Department of Agriculture, Arlington, Va. There the oldtime scarecrow has been supplanted by "Dad" Garrett, who in spite of his 80 summers, is a crack shot. "Dad" is shown at the left preparing to bring down one of the winged pests with his gun

**PAINTING TINY INSECTS,** Miss Eleanor T. Armstrong carries on a strange profession in the National Museum at Washington, D. C. Her subjects "sit" for her under the microscope

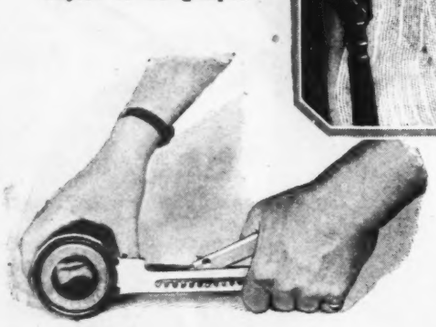
# Better Methods for the Housewife

This convenient lifter for taking eggs and vegetables from boiling water is in the form of pincers with hoop-shaped jaws that slip over the surface of the object to be grasped

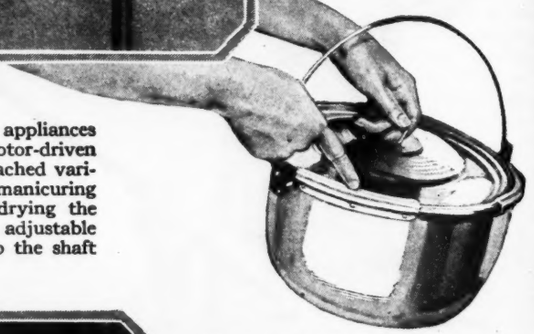
Among the latest electrical appliances for the boudoir is a small motor-driven machine to which can be attached various implements either for manicuring or hair drying. For hair drying the device is mounted on an adjustable stand and a fan is attached to the shaft



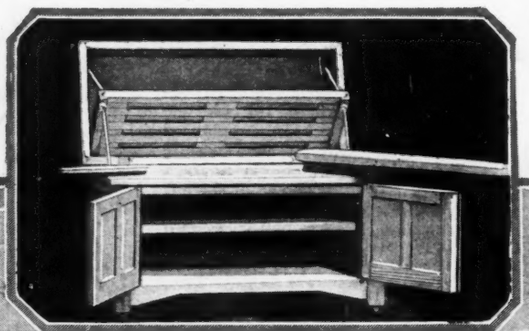
Stationary brackets for food choppers that catch in aprons can be replaced by this folding bracket that will fit any kitchen table. By unscrewing a thumbnut, the device can be folded away



This appliance removes or tightens screw tops on jars or bottles. Tightening the wire cable around the top by pressing the lever removes the cap. Turning the device in the opposite direction tightens it

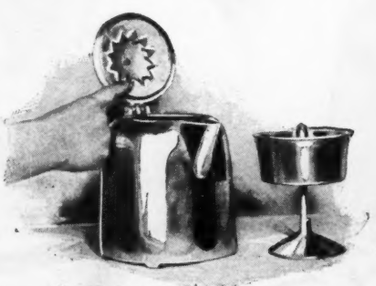


The lid of this kettle locks into bracketed holders on the rim. The lid is held in place tightly while the kettle is tipped to drain water from its contents



When opened, this combination ironing board and clothes chest offers two boards, one large and one small; a tilted rack to hold dampened clothes, and two shelves to receive the clothes after they are ironed

Pressing a button starts an electric motor that spurts water over the dishes from a revolving metal cone



An unbreakable metal top for percolators is said to improve the coffee

This unique four-story cooker utilizes heat usually wasted. Each of the four pots heats the next above



the oil in small atomized particles with the air before combustion. The result is that

3. There should be automatic controls to start and stop the flame.

4. Oil and air feeds should be easily ad-

from the particular burner you are considering. A coal fire needs less chimney area.

# Coal or Oil Fuel—Which?

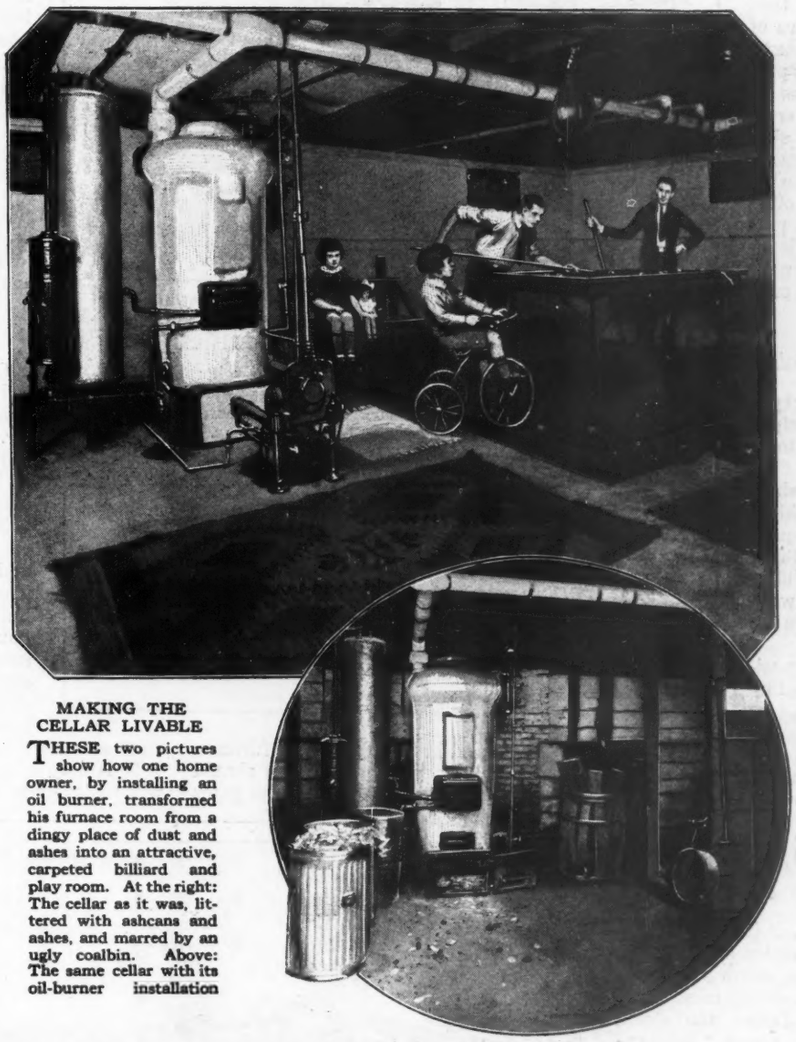
## *A Few Pointers about the Heating Problem in Your Home*

By Collins P. Bliss

*Professor of Mechanical Engineering, New York University*

A FIFTY-CENT broom will sweep a room just as clean as will a $50 vacuum cleaner, yet housewives are using brooms less and less. The reason is obvious. A vacuum cleaner stirs up less dust; it does the work in vastly less time; it is operated easily and it leaves no pile of sweepings to be gathered up.

The comparison between domestic coal furnaces and modern oil burners is very similar. Where oil fuel is used, no clouds of dust come up from the cellar to injure health; a supply of heat is obtained easily and maintained evenly with little trouble, and the disagreeable job of cleaning out the ashes is eliminated.



MAKING THE CELLAR LIVABLE

THESE two pictures show how one home owner, by installing an oil burner, transformed his furnace room from a dingy place of dust and ashes into an attractive, carpeted billiard and play room. At the right: The cellar as it was, littered with ashcans and ashes, and marred by an ugly coalbin. Above: The same cellar with its oil-burner installation

### *Oil as Fuel*

The question often asked is, "Can I use oil satisfactorily as a fuel in my home?" You certainly can if the proper equipment is installed carefully. On the market today are many oil burners that will work equally well in a five-room home or a 25-room dwelling. On the other hand, there are burners that will not work at all successfully.

Burners that have been found to work satisfactorily appear at first to be very complex. Such parts as fans, motors, and thermostats give one the idea that they are difficult to operate. This impression is erroneous. The average woman thinks nothing of driving a car with mechanism more complex than that of the oil burner. The clutch, brake, gearshift, and other parts of the automobile are as nothing to her. Why should she not be able to handle an *automatic* oil burner just as easily?

Attempts to simplify oil burners have not, to my mind, proved successful. I believe that future development will be along the line of improving the present successful burners equipped with positive fuel feeds and with automatic controls. The next few years will see a development in oil burners as remarkable as has been the development of automobiles since 1905.

"What advantage has an oil burner over coal?" is another question.

One advantage is convenience. For example, a thermostat, located in the living room, registers the temperature in the house. When the temperature drops below a predetermined mark, an electric control is operated, the burner lights automatically and the furnace generates heat. Similarly, when the temperature is too high, the burner automatically shuts off. This automatic process continues day and night whether any one is in the house or not.

### *Oil Burner Saves Many Steps*

Obviously there is no need of going into the cellar to shovel coal into the furnace every little while, nor is there night banking of fires and a cold house in the morning.

Then, too, there are no ashes. All the oil burns without soot or smell. The gases go up the chimney and no residue remains. Houses that today require the services of a man to remove ashes can save the cost of his labor by installing an oil burner.

A good oil burner, properly installed, can be operated just as cheaply as a coal furnace. From 140 to 150 gallons of oil in actual use are required to give heat equivalent to that produced by a ton of coal. At 9½ cents a gallon this is equivalent to about $14 a ton. With coal at about $16 a ton at present, it is apparent that oil is cheaper.

### *Installation Cost*

Of course, the original investment with interest must be considered. A coal-burning furnace in a seven-room house can be transformed to an automatic oil-burning furnace for from about $600 to $800. Yet the saving in fuel over a period of years will go a long way toward paying the principal and interest of this investment. Then, too, it is not unreasonable to assume that coal prices will continue to mount as in the past and that they may climb soon toward $20 a ton. At such a figure it is absolutely certain that oil would be the more economical fuel.

To install an oil burner all that is necessary is to remove the grates of the coal furnace, insert the nose of the burner and fasten it in place. A careful survey should be made to see that there are enough radiators or registers to give heating surface sufficient to heat the house. At the same time the most advantageous location for the thermostat should be determined. This is important because a direct draft of cold air or direct heat from any source will cause the thermostat to register falsely.

Another question often asked is, "What type of oil burner shall I buy?" As I said before, numerous types of oil burners are available; they fall under three general classifications: vaporizing, air atomizing, and steam atomizing burners.

In the vaporizing type, oil is fed by drops to a burning vat or bowl, lighted with a match. A jet of air produced by the chimney draft impinges on the surface of the oil, supplying the oxygen for combustion. No attempt is made to mix



# How to Fix Your Plumbing

the oil in small atomized particles with the air before combustion. The result is that much carbon often forms, causing large chimney losses and a poor transfer of heat. While these burners will work well in places where the natural draft is good, they cannot without previous test be applied successfully to every type of house furnace.

The air-atomizing type utilizes the principle that air and minute particles of oil form a highly combustible mixture. The air is provided either by means of electric fans or an air compressor. The air is shot from a nozzle at great speed, sucking oil from another nozzle close by. The oil is broken up into small particles and the mixture is ignited, either by a gas pilot light or by an electric spark plug.

### *Observe These Points*

The steam atomizing type follows the same principle, but uses superheated steam as the carrying agent.

"Which type and which particular burner should be selected?" is the final question to be answered. Since there are a number of different burners that will work well, it is well to observe the following points:

1. There should be a positive air supply, provided by compressed air, fan, or steam.

2. There should be a dependable source of power control for auxiliaries, such as gas or electricity.

3. There should be automatic controls to start and stop the flame.

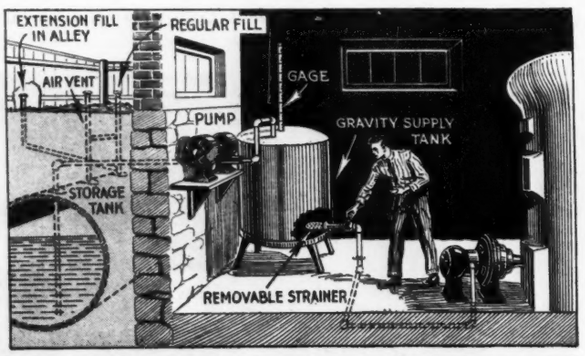
4. Oil and air feeds should be easily adjustable.

5. The burner must fit the furnace. A big burner in a small furnace will only waste fuel and in time injure the furnace.

6. The chimney of your house should be large enough to take away the gases from the particular burner you are considering. A coal fire needs less chimney area.

7. The flames from the burner must not strike an unprotected surface and so burn out the boiler flues, tubes, or other parts.

The oil burning system includes two tanks, the burner, piping, and electric wiring. A large storage tank varying in capacity from about 200 to 1130 gallons, is buried outside the house. City ordinances require adequate protection of this tank. Some localities require a one half to one foot coating of concrete. In other places a covering of sand and a slab of concrete are deemed sufficient. Before purchasing a burner it is well to investigate the local ordinances regarding the installation of furnaces.




Typical installation of an oil-burner system, showing location of oil

### How to Insure against Danger

IN THE use of oil as a heating fuel in your home, a few simple precautions are offered by experts, as follows:

1. Be sure the apparatus is installed in accordance with regulations of fire underwriters and city ordinances.
2. Inspect the system daily. If a pilot light is used, see that the tip is free from carbon. Never use a naked light in hunting for leaks.
3. Before starting the burner, be sure all flues are clean and dampers are open wide.
4. Keep the furnace room free of papers, rags, and other rubbish.
5. Don't allow unignited oil to spray or drip from the burner into the furnace.
6. Don't allow any person to experiment with the apparatus.
7. Have the entire system thoroughly overhauled at the beginning of each heating season, preferably by the company that installed the burner.

### *For Oil Storage*

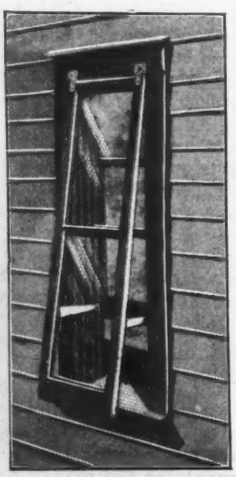
Oil from the buried tank is led to a smaller tank of about 60 gallons in the cellar. Here again some city ordinances require that the oil be pumped into the cellar instead of using gravity.

Many ships long ago discarded their coal bunkers and substituted oil tanks. Then factories, large office buildings, and apartment houses fell in line. Thousands of such installations are now in operation. In all these plants, the boiler rooms look as spick and span as hospital operating rooms.

It is only a question of time when oil will replace coal in many homes also.

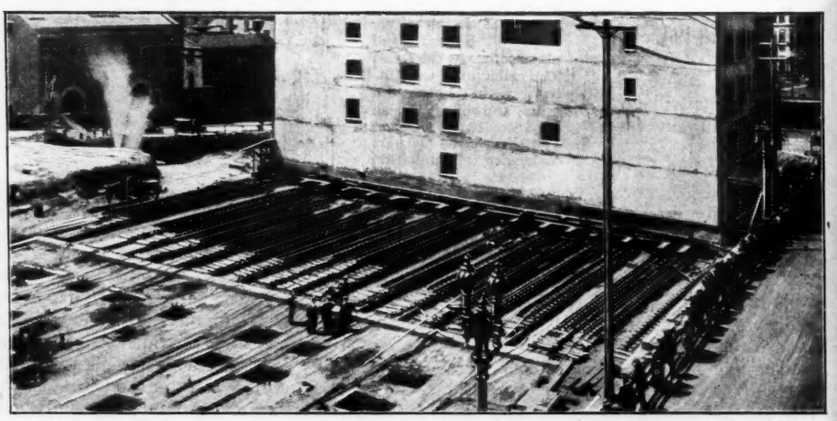
## Storm Sash Opens when Window Is Raised

LIFTING a window, if it is equipped with the clever device shown here, simultaneously lifts the storm sash, thus eliminating the extra effort usually required to raise and fasten the storm sash independently.



How the storm sash is swung open by window

The secret of the device lies in two lifting arms fastened to the inner sash and extending to the storm sash. The outer ends of the arms are fitted with roller bearings that run on tracks attached to the side members of the storm sash. Thus, as the inner window is raised, the storm window swings out.



## Six-Story Building Moved by Six Horses

SIX Los Angeles horses recently accomplished the astonishing feat of moving a six-story brick building, weighing 11,000 tons, for a distance of 125 feet. They did it with the aid of a series of tracks over which the structure moved on rollers.

The building housed a hotel which had to be moved from a site purchased by Los Angeles for municipal buildings.

Nineteen double tracks, a total length of a mile, were used. Forty-five lines of cable, totaling 8100 feet, and three capstans conveyed the power supplied by the horses. The cable, tracks, and capstans were so arranged that the six horses pulled with a strength equal to that of 5400 horses, a multiplication of 900. The moving was, of course, 900 times slower than it would have been with 5400 horses pulling.

Fourteen hundred jacks were used. The distance covered in any day was 40 feet.

# How to Fix Your Plumbing

## *First Aid Methods Any Householaer Can Use when Water Pipes Leak or Burst in Winter*

**By John H. Schalek, M. E.**

**YOU'LL be surprised as you read this article to discover that you don't need to be even a halfway mechanic—you hardly need to know one tool from another—in order to doctor the inevitable plumbing ills about your home. In simple terms an expert mechanic tells just how to do it quickly and effectively. This is one of the most helpful of the articles appearing in POPULAR SCIENCE MONTHLY each month, telling the amateur how to do odd jobs around the house. You'll discover much real recreation and enjoyment in learning how to "fix it yourself."**

The first step in an emergency—turning off the water in the curb box. One full quarter turn shuts off the average cock

TO MOST of us the plumbing systems in our homes are like our teeth—we do not realize that we have them until something goes wrong. Then, when something does go wrong, we are quite helpless. Even the handy man who does a little carpenter work and painting about his home and perhaps tinkers with his automobile rarely will attempt to repair his plumbing, simply because he thinks that plumbing work is difficult and mysterious, requiring a very special kind of skill and unusual and complicated tools.

This is not so. Nearly any man, with the common tools found in almost every household, and without special mechanical skill, can do his own plumbing repair jobs. Most of these are emergency jobs—such as mending leaks that develop suddenly, endangering valuable furniture, rugs, wallpaper, and other household possessions. Every man should know how to give first aid in such cases as these. It is no more sensible to permit a serious leak to ruin your house furnishings while you try to summon a plumber than it is to let blood flow from a cut in your hand while you wait for your doctor.

Locating the curb box with a compass. The compass needle is deflected as you approach the iron box

### *Turning Off the Water*

The first thing the amateur plumber should learn is how to turn off the water supply to the house. In many modern homes a shut-off valve, similar in appearance to the shut-off valve of a steam radiator, will be found beside the water meter.

If there is no shut-off valve in the house, the water supply may be turned off at the curb box. This box usually will be found near the street curb at the front of the house. If the position of this box is not known, often it may be located with the aid of an ordinary compass.

First find the place in the cellar where the water pipe enters; then, following the line of this pipe and holding the compass as close to the ground as possible, walk slowly to the curb. As you approach the iron curb box, the needle or disk of the compass will be deflected and it is then a simple matter to uncover the box and shut off the water with a key.

The water supply can be shut off from certain pipes by turning the valves found beneath sinks and washbowls, or in the cellar. If you do not know what pipes in your plumbing system these valves control, try the valves one after the other, and tag them against possible emergencies in the future.

Faucets and other valves that leak because the washer has become worn, waste an almost unbelievably large quantity of water. Leaking at the rate of only 10 drops a minute, the ordinary faucet will waste about 200 gallons of water in a year. Two leaking hot-water faucets will cost the householder at least a dollar a year in gas alone—enough to pay for 50 good washers.

To replace a faucet washer, first shut off the water from the house. Then close the faucet tight. Next unscrew the large nut connecting the handle with the body of the faucet. When this nut is free, unscrew the faucet by the handle.

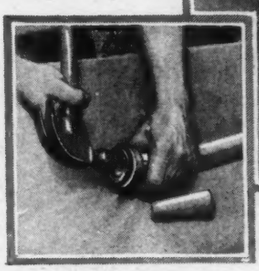
### *If the Screw Is Corroded*

When the core of the leaky faucet is out, look at the small screw that holds the washer in place. If the screw appears to be badly corroded so that it might break off when the screwdriver is applied, cut the washer out with a sharp knife and take the screw out afterward, using pliers if necessary. Trim the new washer around the edges until it fits closely into the recess in the core. Then replace the screw, screw in the core of the faucet as far as it will go, and tighten the large nut.

Leaks at pipe joints—joints where the pipe screws into couplings, unions, and other fittings—are due to strains or excessively worn threads. Unscrew the joint and smear a little thick paint, tar, or other heavy oil compound on the external thread—that is, the thread inserted in the joint.

If this should not stop the leak, coat the thread with a low melting point paste solder and heat with a flame until the solder has

### Severed Pipes Easily Joined



Hammer each severed end over the union; join the half unions

After cutting the broken water pipe, insert each of the severed ends in an ordinary half union. Then chip off the tongue of the union as shown above

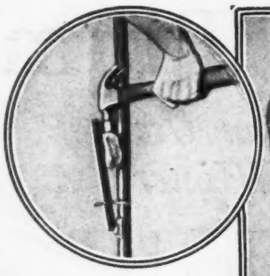
How three sections of pipe are joined tightly by ordinary pipe unions

melted; but do not permit the solder to fill up the threads.

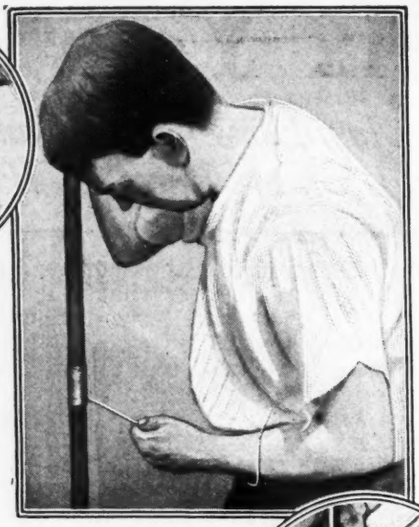
It is well to have some litharge about the house. This is a yellowish powder that may be obtained at any hardware store. Mixed with boiled linseed oil, it forms a thick paste that can be used on pipe threads to make them tight.

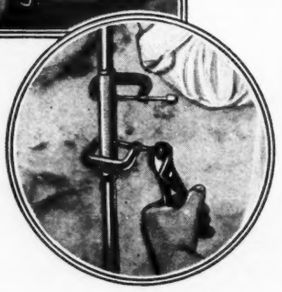
Leaks in piping due to rust and freezing are repaired more easily than is generally imagined. When the emergency arises, two or more machinist's clamps, obtainable at hardware and often at five and ten cent stores, a piece of ordinary rubber gas tubing split longitudinally and a piece of heavy sheet iron will stop even very serious ruptures effectively. If the clamps are not available, an ordinary strap hinge and a large carriage bolt will prove effective.

An emergency leak clamp, successfully used by gas companies on gas lines holding more than 200 pounds pressure to the square inch, also has been used satisfactorily to stop water-pipe leaks.



This simple emergency leak clamp is made of a small stick, a wire, a stone wedge and a piece of rubber. Hammering the wedge toward the wire fulcrum brings pressure on the rubber covering the leak





Two ways to stop a pipe leak temporarily. Above: A piece of rubber large enough to cover the burst section of the pipe is wrapped tightly with heavy twine or wire. At right: Ordinary gas tubing and a piece of heavy sheet iron are fastened about the broken pipe with machinists' clamps

### *Making the Emergency Clamp*

All you need is a piece of wire, a piece of soft rubber, such as gas tubing, auto shoe, or inner tube, a piece of iron to act as a lever, and a piece of iron or wood, preferably in the shape of a wedge. The farther the wedge is driven in, the greater will become the pressure on the rubber packing.

A piece of rubber large enough to cover the burst section of the pipe and wrapped tightly on the pipe with heavy twine or wire also is a satisfactory way of repairing leaks temporarily.

Contrary to popular belief, it is impractical, if not impossible, to repair a leaking lead pipe by soldering. The pipe must be severed and rejoined. Since exceedingly skilful manipulation is required to cut the pipe at the point of leakage and wipe the joint, the following method will prove the simplest for the average man:

Cut the lead pipe with a saw. Select an ordinary pipe union large enough to allow the lead pipe to slip through readily. The tongue of the half union is chipped, sawed, or ground off. One severed end of the lead pipe then is inserted in the union and the end hammered over the union seat. The same operation then is performed on the other end of the pipe and half union. After both pipe ends have been fastened in the union halves, the ends are brought together and coupled by the union ring.

In cases where the rupture is large, so much of the lead pipe must be cut out that it will be found impossible to bring the ends together. In this case two unions are needed. A piece of lead or iron pipe of suitable length is inserted between the unions, bridging the gap between the pipe ends.

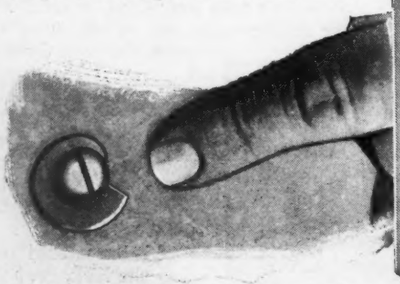
Unions of this size may be bought for about 50 cents each and a job for which a plumber would charge $10 actually can be done for less than one dollar and a half.

When a hot-water storage tank develops a leak, most householders consider it beyond repair. But a small hole can be stopped easily by driving a tapered plug of white pine or walnut into the hole. The writer knows of one case where a plug inserted three years ago is still doing service. The plug should have a very gradual taper with the entering end almost as sharp as a needle. It is driven in with a hammer after it has first been soaked in water and the projecting end cut off within half an inch from the tank surface.

Where the hole in the tank is one quarter inch in diameter or larger, a most effective and workmanlike repair job can be made by using a stove bolt, two inches or more in length, a nut, a rubber washer, and two iron washers. Split one of the iron washers with a cold chisel. Slip the head of the bolt through the hole. Now place the split washer over the bolt and slide the washer against the boiler. Holding the bolt end firmly in one hand, screw the washer in through the hole with the other.

Once the washer is inside the tank, the head of the bolt cannot be pulled out. All that is necessary then is to put the rubber and iron washers on the protruding bolt and screw the nut tight.

## Two Simple Ways to Mend Small Holes in a Boiler



A split washer, screwed in through the leak hole, holds the head of the stove bolt inside the boiler so that it can't slip through

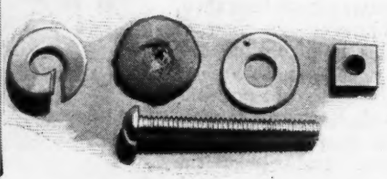
Small holes in the boiler can be stopped either by inserting a tapered wooden plug or by fitting a stove bolt, as shown above

### *Cover All Exposed Pipes*

Leaks resulting from the bursting of frozen pipes cause much plumbing trouble at this time of year. Water pipes should not run in exposed walls. If you have such pipes in your home and they are accessible, they should be wrapped with sheet wool of a thickness of not less than three inches. But the surest way of preventing pipes from freezing is by shutting off the water at night and at other times when the house is without heat. After the water is shut off, the pipes should be drained at faucets, drains and flushes.

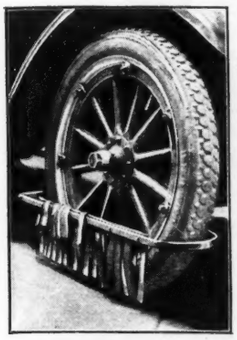
If the house is left vacant in the winter, about two quarts of kerosene should be poured into closet bowls and a pint into each sink, washbowl and bathtub to prevent the traps from freezing and bursting during the severe weather.

These are plumbing jobs that every man should be able to do. Performing such simple repair tasks yourself will save you money—not only in plumber's bills but in house furnishings that easily might be ruined even by a very small leak.

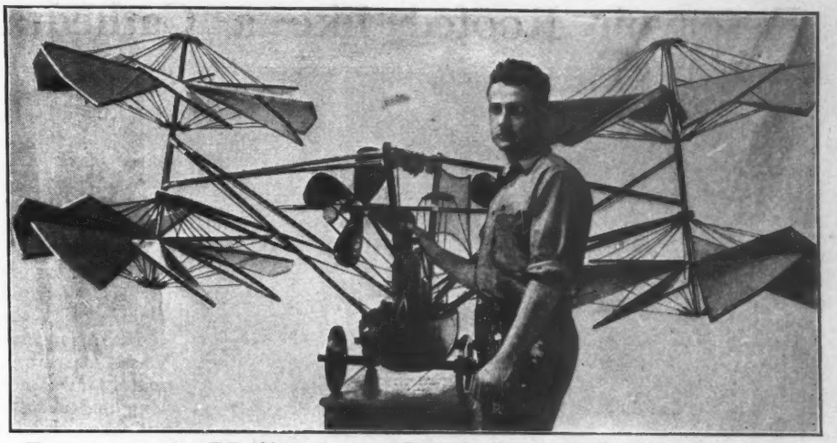


Parts of the stove bolt plug shown at the left — a split iron washer, rubber washer, unsplit iron washer, bolt and nut

## Autos in China Must Wear Mud "Splashers"

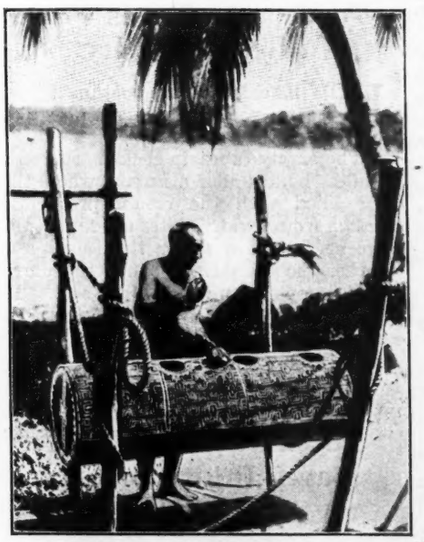


ORDINARY mudfenders are not sufficient in China, for the law there requires that pedestrians, as well as a car and its occupants, be protected from the splashing of mud. Accordingly, all automobiles in China are equipped with "splashers" on all four wheels. Each splasher consists of a strap-iron frame hung from the axle and encircling the wheel, from which hangs a heavy fringe of fiber or leather long enough to touch the ground.



## Remodels Helicopter Invented 80 Years Ago

A MODEL of a helicopter from plans drawn in 1843 by Sir George Cayley was constructed recently by Paul Garber, custodian of airplane models in the National Museum at Washington, D. C. The design, although conceived years before an airplane flew, is strikingly similar to those of recent helicopters.



## Broadcasting in the Jungle

THIS is a broadcasting station in the South American jungle—an amazingly noisy signal drum hollowed out of a log and used by the Tucanos for maintaining communication when hunting.

## Playing with Thunderbolt

THE scientific experiment of passing more than a million volts of electricity through one's body ordinarily would terminate one's scientific career. But Earl Holm, a senior at the University of California, Berkeley, Calif., here is shown performing that experiment with impunity, manufacturing thunderbolts as nonchalantly as might ancient Vulcan.

The secret of his apparent daring lies in septuple insulators on which the "operating" chair rests.

## Strange Spider Monkey and Its Baby Captured

THIS spider monkey with her baby, which is said to be the only one in captivity, recently were presented to the San Diego, Calif., zoo by a detachment of United States marines stationed at Nicaragua. The spider monkey is so called on account of its extremely long, slender limbs and long tail. These are constantly employed in climbing.

## This Pig Walks on 26 Toes

ON A Nebraska farm recently a pig with 26 toes was born, one of a litter of seven, the others being normal. Both front feet are double, and the left hind leg terminates in a veritable cluster of toes.

# Reservoir Roofed like a Cathedral

A forest of columns, 35 feet high, supports the enormous roof

THIS covered reservoir of reinforced concrete, an unusual piece of construction on account of the magnitude of its dimensions, was completed recently for the waterworks of Cleveland, Ohio.

Its enormous roof, approximately 1000 feet long and 500 feet wide, consists of groined-arch panels, supported by a forest of thick columns. Standing within the Baldwin Reservoir, one could readily imagine himself in a great cathedral.

The volume of concrete used in making the units —walls, 1196 columns, 2208 groined-arch panels, and as many sections of floor slab—amounted to 104,100 cubic yds.

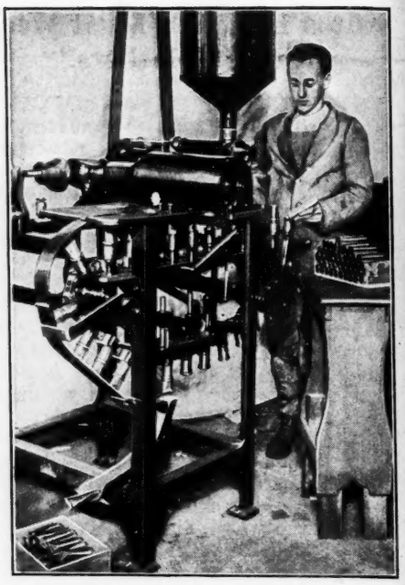
# Uncle Sam Builds Huge Army Tanks

TANKS with many times the terrible destructive force of those that proved so deadly in the closing months of the Great War are being developed in experiments at Camp Meade. The illustration shows a lately evolved model splintering trees on the testing ground.

Not all of the experimental work is with fighting tanks. Tanks that can transport large guns, ammunition, infantry, signal apparatus, construction material, safely and rapidly for miles over ground deeply pitted with shell holes and blocked by obstructions are vital to the success of the terrible fighting tank.

Testing one of the huge new army tanks over rough country

"BALSAM wool," a new heat insulator and sound-deadening material for buildings, excelled only by human hair and sheep's wool in insulating efficiency, is prepared from pulp, wood bark, and sulphite screenings. It is flexible and resistant to fire and water. It weighs only 253 pounds to 1000 square feet.

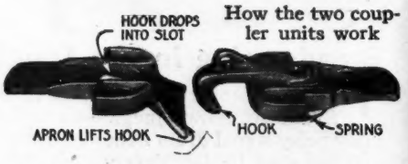


## Toothpaste Tubes Filled by Machinery

HOW machinery puts toothpaste, cold cream, and shaving cream into the tubes is pictured above.

The empty tubes, in sockets, run on an endless band under a nozzle, where they are filled with the cream preparation drawn from a vat. After the filling, they are carried to a sealer that clamps together the open ends, bends them over, and stamps them into a tight seal. The tubes are held in place by the semicircular metal strip shown at the left until they are directly above a chute, which conveys them to a packing box.

## Automatic Car Coupler Saves Injury to Crew




AN AUTOMATIC safety coupler for mine cars has been perfected to lessen the number of casualties caused by the crushing of hands and bodies of workmen in making up trains of cars and later in uncoupling them.

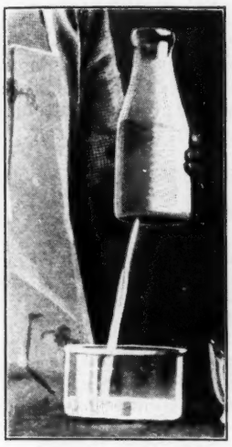
The coupler is made in two sections, one fitting on the rear of the car and the other on the front. When two cars thus fitted are rammed together, an apron on one section of the coupler raises a hook on the other. This hook immediately drops into a slot in the first apron.

Sufficient play is allowed in the hook connection to prevent breaking of the coupler due to impact when the train is started with a jerk.

WHEN soft coal is burned in the furnace, soot can be removed quickly and easily from flues and heating surfaces by throwing a pound of common salt, thoroughly dried, on the burning fuel bed. Immediately upon charging with salt the furnace becomes filled with dense, white fumes.

## This Milk Bottle Uncorks at the Bottom

A MILK bottle that uncorks at the bottom, making it possible to draw off the milk while retaining the cream in the bottle, has been invented by Ray Dunn, of Tipton, Ia.



The bottle has a small opening at one edge of its bottom surface. This opening normally is closed by a cork to which is attached a cord or tassel. When the cork is pulled out, the milk will flow from the bottom of the bottle, thus making it easy to empty and solving the problem of separating the milk from the cream.

The hole also assists in cleaning the bottle, which is filled in the usual way.

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TO MAKE sure that a ring or other piece of jewelry is gold, drop it in nitric acid. Neither gold nor any precious stone will be harmed. The acid quickly attacks imitations, whether they be of precious stones or of gold.

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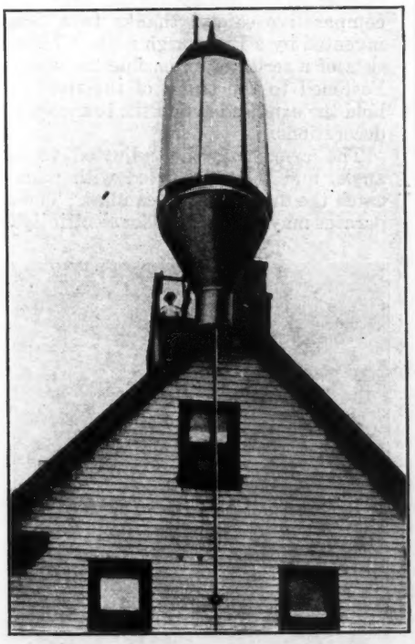
## Windmill Supplies Light



BY INSTALLING a windmill on his roof, a resident of East Cleveland, Ohio, lights his home almost without cost.

The windmill consists of eight perpendicular "sails" attached at top and bottom to circular, revolving frames. These are connected with a special one-kilowatt generator. The windmill is about 15 feet high and 50 feet above the ground.

Above: A diamond-bearing river bed exposed by diverting the stream from its course. At the right: Crushing blue clay from the mines to expose the gems for gathering

# How Kimberley Diamonds Are Mined

TWO methods by which the diamond, king of gems, is thieved from Nature's treasure chests are revealed by the illustrations above, showing scenes in the famous Kimberley district in British South Africa.

The larger picture shows a diamond-bearing river bed exposed by diverting the stream. Such streams carry diamonds down their course much as many Western streams in the United States bear down nuggets. Claims are staked out in the dried bed, 50 per cent of the value of the discoveries going to the Government and 50 per cent to the claim holder. As in placer mining, virtually no digging is necessary, many of the stones lying on the surface.

The smaller picture shows a tractor crushing clods in a blanket of blue clay that has been brought up from the diamond mines and spread over the ground. This clay lies weathering for a year, during which it is plowed and smashed frequently. The conditioned clay then is taken to a separating mill.

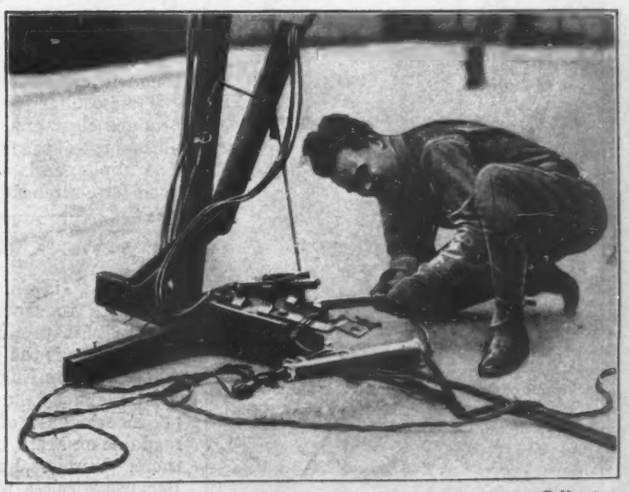
Barbed wire charged with a deadly electric voltage guards the field.

# Manufacturing Lightning in Movies

THIS machine produces flashes of lightning for moving pictures. The flashes are quite harmless, but are realistic enough to be terrifying when viewed on the screen.

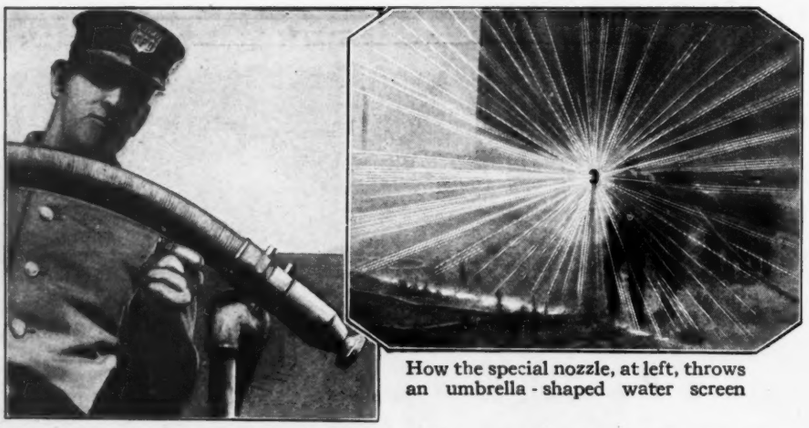
The apparatus, which is of wood, is wired like a street arc lamp, except that several carbons are used instead of only two. About a half dozen of these are fastened to an upright arm and a single large carbon to a projecting arm. The latter can be moved back and forth by the attached rope.

When the single carbon is brought in contact with the group, a great flash of light is produced, registering with spectacular effect on the moving picture film.



© Keystone

**The arclight machine that produces dazzling lightning flashes**



How the special nozzle, at left, throws an umbrella-shaped water screen

## Nozzle Throws Water Barrage for Firemen

A UNIQUE type of fire hose nozzle, which, in addition to throwing a stream on a fire also supplies a curtain barrage of water to protect firemen from the heat, has been developed by a San Francisco concern.

A recent demonstration proved that the umbrella-shaped screen of water nullified the effect of the heat sufficiently to permit firemen to insert the nozzle into a tank of burning gasoline. Also, the protecting stream, by cutting off the supply of oxygen from the fire, caused it to be extinguished almost instantly, a thing it would have been difficult to accomplish with the ordinary solid stream.

Using this nozzle, one man can handle a line carrying 150 pounds pressure.

## Springs to Heat Iceland

ICELAND is planning to utilize its natural hot springs and geysers in place of coal to heat the whole country, according to reports from Bergen, Norway. Preliminary plans call for wooden pipe lines to carry the hot water from the springs to the cities.

## Rocker Quickly Converted into Wheel Chair

CONVERSION of a rocker into a wheel chair is accomplished in a few minutes by clamping to its base the special set of four wheels as shown below. The small rear wheels turn in any direction for steering. The foot rest is adjustable and the front wheels can be locked in position. A nurse evolved the invention.

A wheel chair made from a rocker

## Novel Megaphone Amplifies Voices of Singers

E. W. CORNELL, of Adrian, Mich., has designed this strange megaphone for use by singers. The large flare of the funnel is said to furnish amplification of tone without distortion.

The peculiar face piece was devised to produce clear enunciation by permitting normal use of the face and mouth muscles. The appliance is said to be particularly good for church singers and broadcasting.

## Says We Can Signal Mars

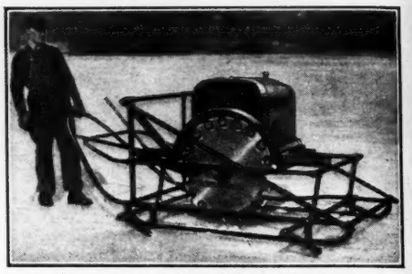
THAT it is entirely possible for the earth to signal Mars by means of signal lights produced at high altitudes by airplanes is the belief expressed by Dr. A. M. Low, an English inventor.

By chemicals, he says, there are ways to produce signals of sufficient size to be readable on Mars, if intelligent beings live there. Wireless, he says, is impracticable. Because wireless waves travel in curves, he observes, it is hard to hit the target.

## One-Man Ice Saw Driven by Auto Engine

AN INGENIOUS ice saw driven by an automobile engine cuts nine inches deep at the rate of three feet a second. It is the invention of S. E. Kurtz, of Sac City, Iowa.

The saw is connected directly with the crankshaft of the auto engine, eliminating the transmission. Because of its lightness, automatic spring saw hoist, and automatic gage fingers, one man can operate it.



An auto engine drives the saw

## Hope for O. D. Uniforms

THE American Chemical Society is attempting to perfect a domestic dye that will make the faded O. D. uniforms of General Pershing's men look alike in color.

## [Safety Candle Holders for the Christmas Tree

PERSONS whose homes are not wired for electricity may use lighted candles for Christmas-tree decoration with comparative safety, thanks to a device invented by a Pittsburgh man. This consists of a series of extensible metal arms. Fastened to the trunk of the tree, they hold the candles beyond the branches and decorations.

The arms may be adjusted to any angle, and they are fitted with pans to catch the drip from the candles. The apparatus may be used also for electric lights.

Arms hold candles away from tree

© Keystone

## Gas Stove Placed in Tub Heats Bath Water

UTILIZING an odd design of gas stove, a German inventor has devised a quick method of heating water for the bath. After the bathtub has been filled with cold water, the gas stove is placed in the tub until the water is hot enough.

The design of the stove permits a maximum of heat to be transmitted to the water without danger of explosion or extinguishing the flame, for the flame jets are in the upper part of the stove and the lower part is watertight.

## Handle of Walking Stick Serves as Flashlight

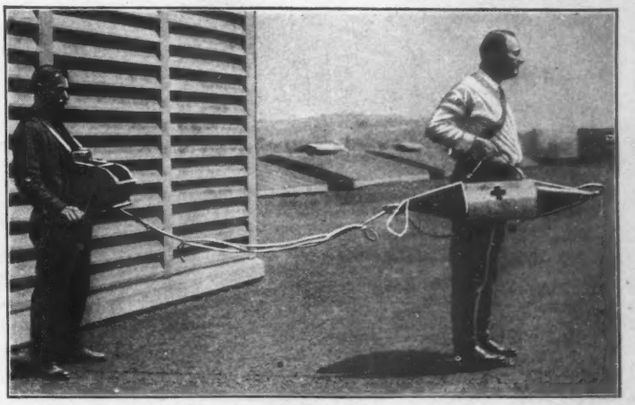
THE difficulties and hazards of walking over rough roads by night are greatly lessened by this ingenious combination of walking stick and flashlight. A battery and lamp are set in the handle of the stick, the lamp being attached in such a way that it appears to be only a metal cap for the handle. The pushbutton activating the lamp is located inconspicuously under the handle. Finding small change, reading house numbers, or looking at one's watch are illustrations of the invention's usefulness.

## Aspirin Freshens Flowers

THE best way to revive withering flowers is to dose them with aspirin, according to the announcement of a French scientist. He claims to have discovered that an ordinary aspirin tablet dissolved in warm water will freshen the most delicate cut flowers in vases.

# Bathers Rescued by Novel Lifeline

THREE drowning persons were rescued recently from what is said to have been one of the roughest surfs ever recorded on the Pacific coast by a remarkable torpedo-shaped life-saving buoy that enabled the rescuers to carry a life-line to the persons in distress.



The rescuer swims with the buoy attached to reeled line

The device has a range of 1000 feet from shore and weighs but 25 pounds. Two persons, only one of whom need be a swimmer, operate the apparatus.

A reel containing 1000 feet of sounding wire is suspended from the shoulders of the man on shore. It is attached also to a wide belt about his body so that the strain of pulling in the reel is distributed. Connected with the reel by a sounding wire is a cylinder, with torpedo-like ends to cut the water. The wire connects also with a harness worn by the second man, who swims out with the buoy to the victim. The cylinder has great buoyancy and, it is said, can be carried nearly twice as fast as the standard carry life-buoy.

If the wire becomes entangled in seaweed or wreckage, the rescuer releases a snap swivel that frees him from the wire and swims in, using only the cylinder.

# Concrete Granary Filled by Motor

A CONCRETE granary and corncrib, scientifically ventilated and containing a motor-driven elevator that fills it automatically, has been designed and constructed by F. W. Benjamin, on his farm at Bloomington, Ill.

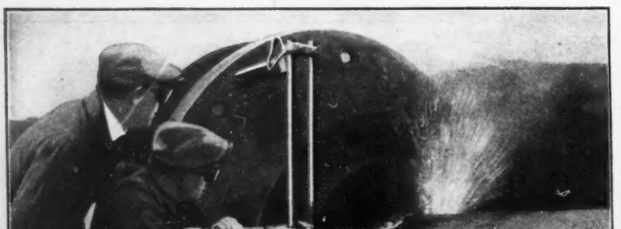
While the building follows the design of the familiar silo, it is constructed of concrete staves. On two sides of the building the staves are supplied with vent holes that permit the air to circulate through the stored fodder and prevent it from spoiling.

Under the structure is a passageway large enough to admit a horse and wagon or motor truck when the fodder is being stored. The corn or grain is dropped from the rear of the wagon into a trough, whence elevators convey it upward and store it automatically when a motor is started. The fodder is removed from the crib by gravity. The designer of the granary points out that it is fireproof, ratproof, and does not have to be painted.

Buildings of this sort are adapted not only for the farm, but may be used also for the storage of coal and similar materials.

The concrete granary and its storing machinery, showing motor-driven elevators that convey corn from the wagon

# World's Biggest Torch-Cutting Job

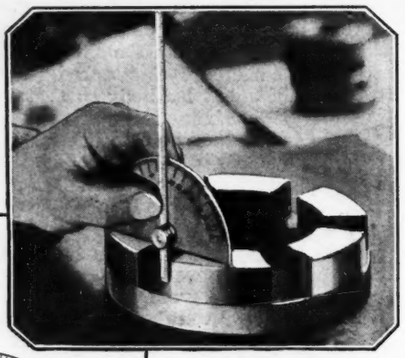


UNDER the fierce heat of an acetylene torch, the 27-inch solid steel shaft shown here was cut in two in about 15 minutes recently in a railroad yard in Los Angeles, Calif. This is said to be the biggest job of acetylene cutting ever undertaken. Sixteen tubes of oxyhydrogen gas were consumed, maintaining a constant temperature of 3500° F.

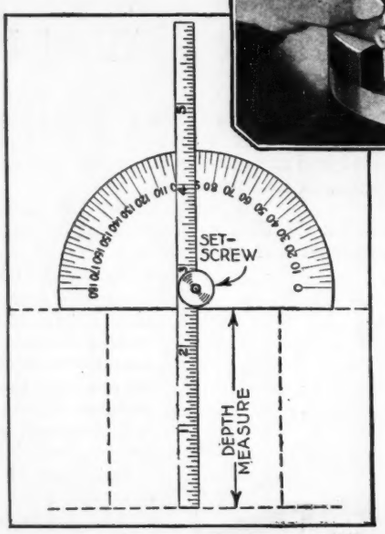
## Protractor and Depth Gage Combined in One

A RECENT contribution to the list of time-saving machine tools by a concern in Athol, Mass., is a combination protractor and depth gage in which the protractor arm serves as the blade of the depth gage. Any desired angles can be laid off or measured and the depth of machined channels can be determined.

When the device is used as a protractor, any angle in one half a circle can be laid off with the blade, and the angle of a piece of work measured. For use as a depth gage the blade can be set at any length within six inches. When thus used, a set-screw is loosened and the blade set to project any distance below the protractor base. Lining up the blade along the 90° mark at the top insures accurate measurement.

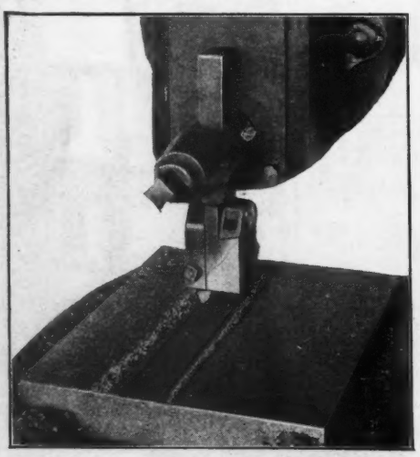


Above: Measuring the depth of a slot in a machined casting with the adjustable protractor-depth gage




At the left: How the protractor arm serves as the blade of the depth gage. For adjustment, the set-screw is loosened and the blade set to any desired depth

## Combination Machine Tool Cuts Two Ways



Roughing and finishing with two-way tool

THIS novel machine tool and holder, designed for cutting on both the forward and return strokes, is the recently patented invention of a Chicago shop foreman.

The device is equipped with two cutters, one a roughing tool, and the other a finishing tool. On the forward stroke the finishing tool rides over the work while the roughing tool makes a cut. On the return stroke the operation is reversed.

Finally, when the tool-holder has been fed all the way, the surface of a casting or other work is finished.

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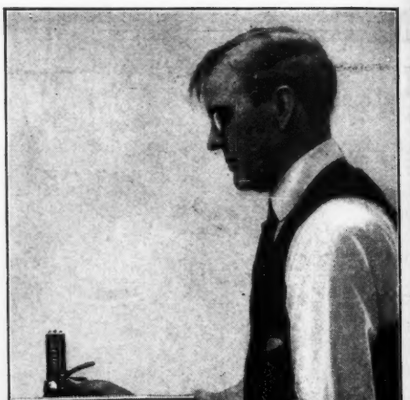
DEVELOPMENT of a new system of making iron castings from "long-life molds" has been announced by a carbureter manufacturing company of Detroit, Mich. The new mold, it is reported, will produce six two-pound castings a minute.



Setting hand saw with rotary tool

## Hand Saws Set in Minute by New Rotary Tool

A ROTARY saw set recently patented is said to set a hand saw accurately in one minute. Guide bars hold the saw in place and an adjustment at the bottom, by a turn to the left or right, accommodates the particular width of the saw being set.

Different set wheels are required for saws with varying numbers of points to the inch. These are changed easily. Drawing the set once the length of the saw completes the setting.

## Barrel-Header Is Driven by Oil Pressure

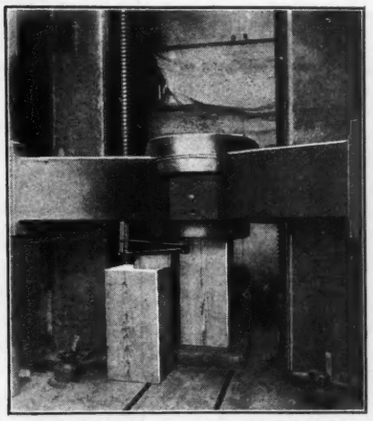
AN ENTIRELY self-contained barrel-heading press, driven by oil pressure has been devised by a Florida man.

A pump supplying the pressure is mounted directly on the base of the machine and connected by a short nipple with the base casting. In this casting are oil passages and a rotary valve controlling the operation of the plunger. The oil reservoir is cast into the base of the machine. Two operating pedals raise and lower the press.

Oil pump applies pressure to head

# Million-Pound Pressure Proves Strength of Knotty Wood

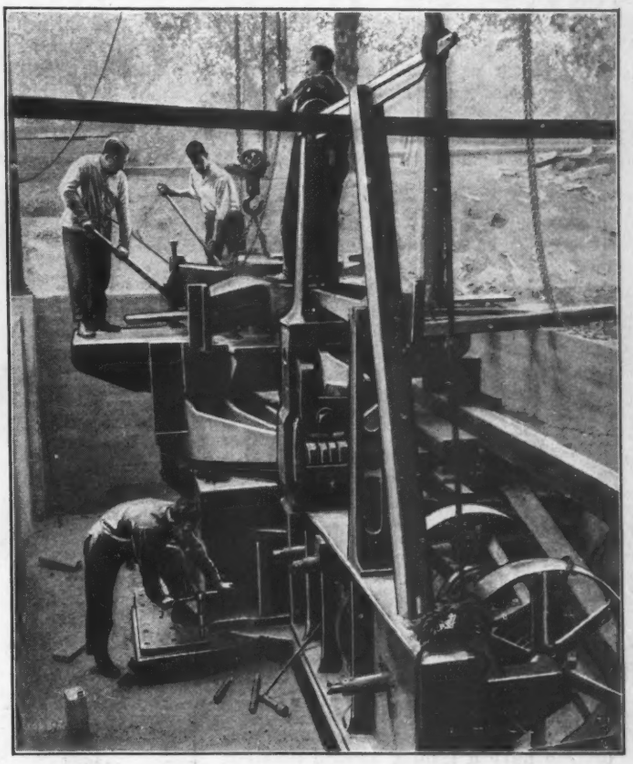
SCIENTIFIC tests recently completed in the laboratories of the United States Forest Service at Madison, Wis., have exploded the theory held by builders that knots in timber necessarily impair seriously its supporting strength. By means of a huge machine that applies a vertical pressure of 1,000,000 pounds and is capable of receiving timbers 30 feet long and 12 inches square, it was demonstrated that knots have virtually no influence on the stiffness of timbers, and so, little effect on the column strength.



A short column of yellow pine under tremendous pressure in the million-pound test machine

This discovery, the laboratory officials say, is of immense importance, since many thousands of dollars now are wasted annually in building operations by discarding knotted timbers or using timbers larger than is needed to support a load.

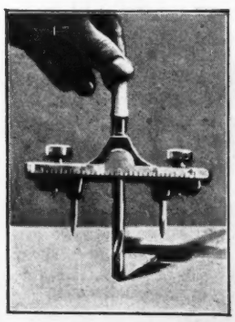
The results of the recent tests, however, do not mean that knotted timbers are to be deliberately sought, since knotted timbers come from the upper portions of trees, and have less density and elasticity than wood from the lower trunk. In the tests Southern yellow pine was demonstrated to have a column capacity as high as 432,600 pounds.



The massive construction of the timber-testing machine, capable of exerting a million pounds pressure, is shown at the right. The machine weighs 150,000 pounds

## New Adjustable Drill for Metal or Wood

A NEW adjustable tool for cutting circular holes in sheet metal, wood, or fiber has been perfected by a tool-manufacturing concern in Cincinnati, Ohio. A lead hole is first drilled by a central drill, to which the tool-holding frame is attached. On this frame slide two cutting blades, which can be adjusted to cut holes from one to four inches in diameter and up to seven-eighths inch deep.



The frame of the tool is of malleable iron, while the two cutting blades are of tool steel, ground and tempered. Adjustment is accomplished by means of two knurled thumbscrews. A scale on the metal body aids in obtaining accurate diameter dimensions.

The tool is especially useful for work on automobile dashboards.

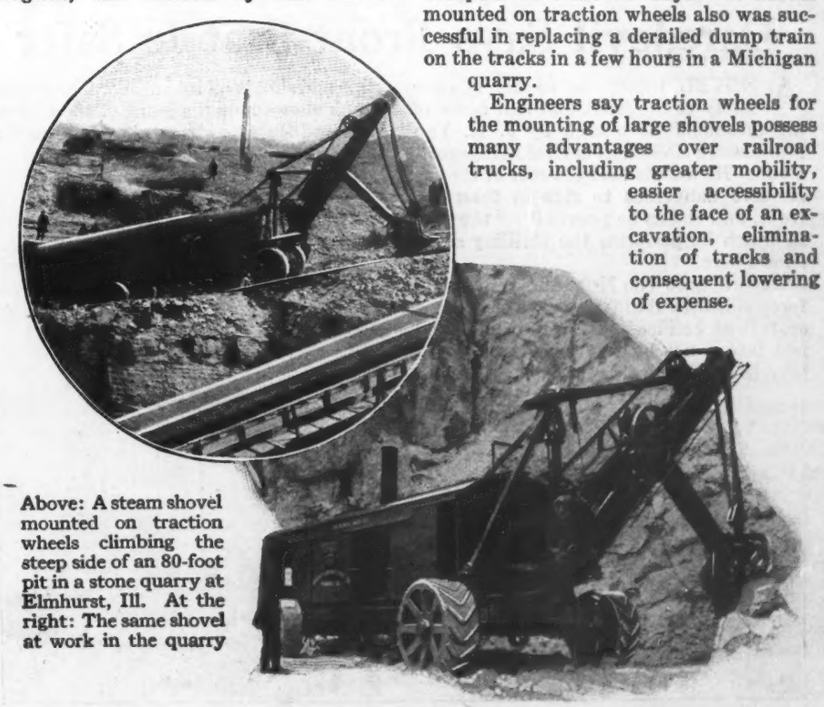
**THE editor will be glad to supply, wherever possible, the names and addresses of manufacturers of devices mentioned in this issue of POPULAR SCIENCE MONTHLY.**

# Huge Steam Shovel Is Hill Climber

STEAM shovels of such size that manufacturers never before attempted to mount them on anything but standard railroad trucks recently have been successfully equipped with traction wheels, giving them extreme mobility and the ability to ascend and descend steep slopes easily. The shovels are hauled by the forward wheels, driven by powerful shovel engines, and steered by rear wheels.

In a quarry near Chicago a shovel 85 feet long, with traction-wheel equipment recently descended into and climbed out of a pit 80 feet deep. Such a feat would have been all but impossible for the same machine on tracks. At a Pennsylvania quarry a huge traction wheel shovel was moved in one day a distance that under the old track-laying methods would have occupied at least 10 days. A shovel mounted on traction wheels also was successful in replacing a derailed dump train on the tracks in a few hours in a Michigan quarry.

Engineers say traction wheels for the mounting of large shovels possess many advantages over railroad trucks, including greater mobility, easier accessibility to the face of an excavation, elimination of tracks and consequent lowering of expense.



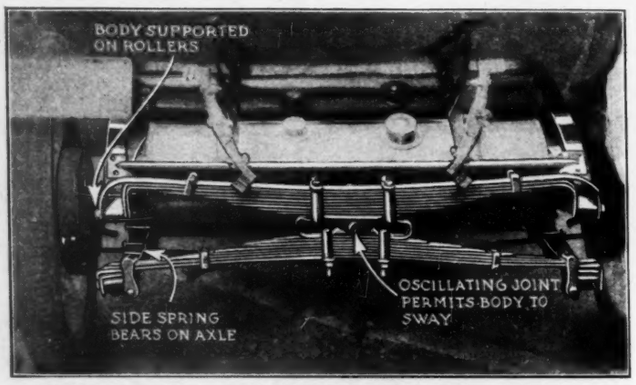
Above: A steam shovel mounted on traction wheels climbing the steep side of an 80-foot pit in a stone quarry at Elmhurst, Ill. At the right: The same shovel at work in the quarry

# Relief Springs Smooth Rough Roads

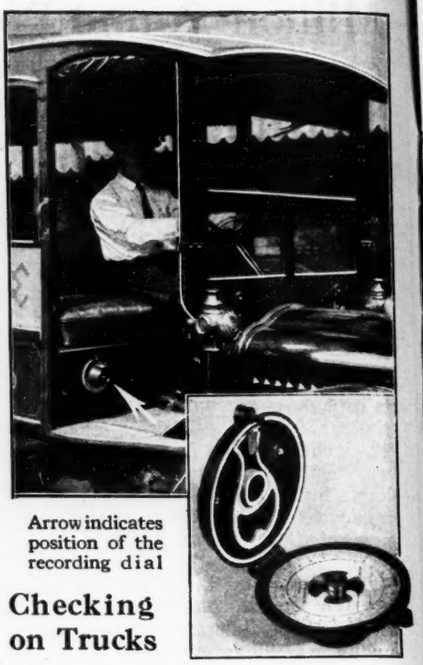
AUXILIARY springs of a distinctly new type that are claimed to give Pullman-car ease on the meanest road, may be attached to most makes of automobile at small cost.

The rear auxiliary relief spring is composed of double transverse, straight laminated springs. These are secured together at their centers, with a roller-bearing oscillating joint between. Each end of the upper spring is connected with the side frame by a roller-bearing device, and each end of the lower spring is held in contact with the main side springs by a rubber - padded stirrup with a ball bearing between the springs. This gives a frictionless connection and allows a great range of spring or axle movement. It provides also a three-point suspension for the rear of the frame.

It is said that this arrangement reduces the effect of end thrust movement and side sway and will damp out sharp rebounds.




The rear auxiliary relief, showing double transverse springs with roller bearing joint, and roller bearing body support



Arrow indicates position of the recording dial

## Checking on Trucks

TO KEEP track of the movements of motor trucks or delivery wagons, a Cleveland manufacturer has devised the ingenious dial recorder shown here. It may be attached to the dashboard, beneath the seat or to any other convenient part of the body.

A dial of paper surfaced with wax, on which are marked the 24 hours of the day, divided into 10-minute intervals, is contained within the case and attached to clockwork that causes it to make a complete revolution once in 24 hours.

The case also contains a pendulum that swings from side to side with the sway of the car. To this pendulum is attached a sapphire-pointed stylus that scratches the waxed paper as it moves.

Moving along the edge of the dial, this stylus records when the car was moving or at rest.

# Views Scenery in Auto Telescope

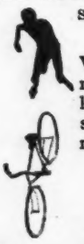
MOTORISTS who may wish a closer view of attractive bits of landscape, or who have a leaning toward amateur astronomical investigation, will be interested in the homemade automobile telescope that a Vermont man has attached to the windshield of his car. The instrument is mounted on a ball-and-socket bracket, permitting it to be set in any position to observe earth or sky. An eye piece with a half-inch focal length enables observations to be taken without getting into uncomfortable positions and also magnifies the images in the telescope 40 times.

The telescope has a 3½-inch mirror with a focal length of 20 inches.

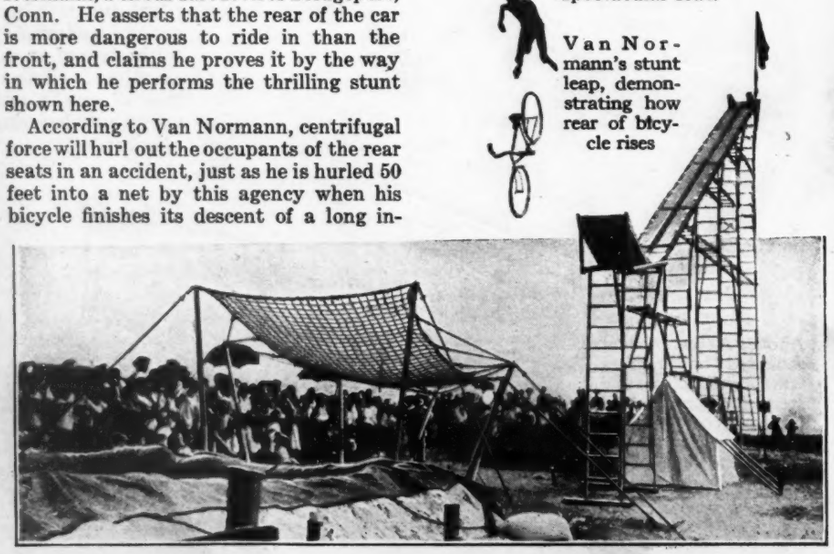
# Daredevil Says Front Seat Is Safer

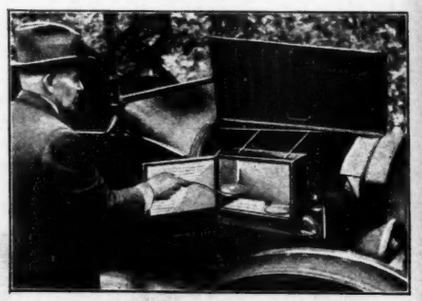
A NOVEL theory as to the relative safety of the front and rear seats of an automobile is offered by J. H. Van Normann, a circus daredevil of Bridgeport, Conn. He asserts that the rear of the car is more dangerous to ride in than the front, and claims he proves it by the way in which he performs the thrilling stunt shown here.

According to Van Normann, centrifugal force will hurl out the occupants of the rear seats in an accident, just as he is hurled 50 feet into a net by this agency when his bicycle finishes its descent of a long incline and shoots off into space. The photograph shows how the front of the bicycle falls and the rear rises as he performs the spectacular feat.



Van Normann's stunt leap, demonstrating how rear of bicycle rises





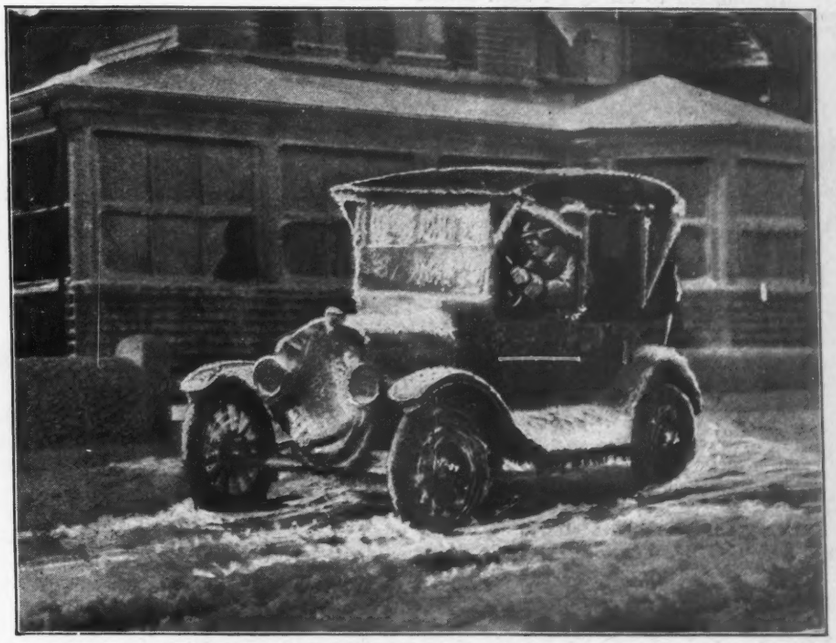
## Auto Engine Cooks Meals while You Ride

AN OVEN attachment for automobiles has been perfected by James E. Z. Fowle, of Preuss, Ore. The oven has a compact rectangular casing, shaped so that it will seat snugly over the exhaust manifold of the engine.

The top carries two rods terminating in hooks that engage over the radiator stay rod, thus holding the oven securely. Coffee, stews, and boiled eggs may be prepared while the car is in motion. Hot cakes or fried eggs can be cooked on a hot plate at the bottom of the oven.

# How to Enjoy Your Car in Winter

**By George A. Luers, M.E.**
*Noted Auto and Mechanical Engineer*



Operating an automobile in winter is a different thing entirely from driving the same car in summer. An automobile is like a human being—to weather the transition from warm sunshine to the snow and ice and freezing temperatures of winter it must be prepared for the change

AS I was walking down the steps of my home one morning early last December I saw a neighbor standing at the curb. He was gazing with pained expression at his automobile, a smart car of a well known make, bought only a few months before. As he heard me approach he looked up and pointed silently toward the front of the car.

Water was pouring from the bottom of the radiator in a flood.

## *Radiator Was Only Half Drained*

"Frozen, eh?" I observed, for the night before had brought the first really cold weather of the year.

"No," he denied. "It can't be frozen. I haven't used the car in a week, and I drained the radiator the last time I put the car away. I noticed it was leaking when I started to back out just now. I can't understand it."

I stepped to the front of the machine to examine it. The core—the honeycomb-like center—of the radiator was split where it joined the lower tank and along the fissure was a strip of ice. I puzzled for a full minute before I found a possible explanation; and, when I questioned the car owner, my guess proved to be correct.

Instead of actually draining his radiator in the only way in which it can be done thoroughly—by removing the plug at the bottom of the lower tank—my neighbor had attempted to draw off the water by turning the cock beneath the water pump. This had permitted the water to flow from the upper part of the radiator, but because the cock is on a level with the lower tank, this tank had been left full. The water had frozen when the temperature fell the night before. As a result a new radiator core was necessary before the car could be used again and this meant a heavy repair bill.

## *Freezing Water Is Common Trouble*

My neighbor's experience is a typical instance of the sort of trouble into which ignorance, inexperience, and carelessness often bring motorists during cold weather. Operating an automobile during the winter is a different thing entirely from driving the same car in milder seasons. The automobile has been improved in a thousand ways since the days when every owner put his car up for the winter, but not yet can it accomplish the transition from relatively warm weather to cold unless it is prepared for the change.

Everybody knows that water freezes, yet the most frequent cause of trouble and expense to the winter driver remains the freezing of the water in the cooling systems of cars. The man who lets this happen deserves little sympathy. You know when cold weather may be expected, and you should prepare your car for it in advance.

Before the first cold weather comes drain your radiator at night. Better still, fill it with an alcohol or other non-freezing solution. It is better to pay for a few pints of alcohol which you really do not need than to be forced to pay a bill for a split radiator, broken pump, or cracked water jacket.

There are many anti-freezing compounds that you may use, but denatured alcohol is as efficient as any and is probably the most easily obtained. A proportion of one-fifth alcohol to four-fifths water will prevent freezing at temperatures above 15 degrees, while a mixture of half alcohol and half water will not freeze above 34 degrees below zero.

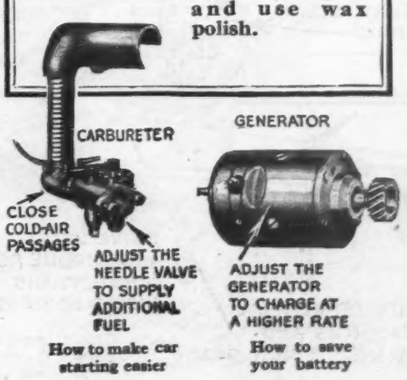
Since anti-freeze solution is somewhat expensive, it is well to prevent loss by leakage by inspecting the hose connections, gasket and pump packing and renewing any of these which may require it.

As a further precaution a leather radiator cover is valuable for retaining heat when the engine is idle.

### Preparing Your Car

HERE are important pointers to observe in preparing the body of your car and its accessories to weather the snow and ice and bitter cold of winter:

| | |
|---|---|
| **TOP** | Repair breaks and untacked seams. |
| **CURTAINS** | Replace broken or discolored glass. |
| **WIND-SHIELD** | Fasten bolts, oil hinges and provide a wiper. |
| **DOORS** | Adjust lost-motion devices, oil latches and hinges. |
| **BODY** | Tighten frame bolts and dash bolts. |
| **FENDERS** | Tighten nuts on brackets and braces. |
| **PAINT** | Enamel bare spots and use wax polish. |


CARBURETER
CLOSE COLD-AIR PASSAGES
ADJUST THE NEEDLE VALVE TO SUPPLY ADDITIONAL FUEL
How to make car starting easier
GENERATOR
ADJUST THE GENERATOR TO CHARGE AT A HIGHER RATE
How to save your battery

## *Some Ordinary Winter Precautions*

Cold weather also affects lubricating. Oils will congeal in the winter, making the engine and transmission stiff. This requires much additional power from your battery in starting, and tends, of course, to discharge it. Light grades of engine and gear oil should be used in winter unless, of course, the manufacturer of your car expressly advises against this. The lighter oils will remain more fluid than heavy oils in cold weather and consequently will reach bearings and gears more readily.

Tire trouble, too, is frequent in winter. Chips of ice cut the casings; water from melting snow seeps into the cuts, freezes and rapidly destroys the rubber and carcass. You will do well, then, to start the winter with a set of new tires, to make frequent inspections and to repair cuts as they develop. A set of good tire

chains for use on icy, snow-covered or sloppy highways is, of course, an essential.

In addition to caring for such details as these, a thorough inspection of the car to detect and correct possible mechanical defects should precede its winter use.

In the winter you need all the power your motor can develop. Be sure there is no loss of power through leaky compression or worn valves. If the motor turns over easily on compression strokes, it is a sign of leaky compression which should be corrected by a new set of piston rings. Then inspect the valves and guides. If they are worn, they should be replaced.

## *When the Lubricant Congeals*

Congealed lubricant in your transmission case will make the action of your transmission sluggish. To compensate for this, adjust the sliding gears for free movement and increase the tension of the clutch springs.

When the highways are covered with snow or ice, your brakes are under an exceptionally heavy strain. For safety in winter driving, be certain that your brake linings are not worn. If they are, have the brakes relined before you risk driving your car. The brakes should be adjusted loosely for winter driving, so that grit, thrown against them from wet roads, will not wear the linings out too fast.

Sharp turns are dangerous in winter, because of slippery traction. For this reason your steering gear should be adjusted so that the lost motion in the steering wheel will be slight—not more than an inch. The steering gear should not be made so tight, however, that the wheels cannot be swung instantly to counteract the least tendency to skid.

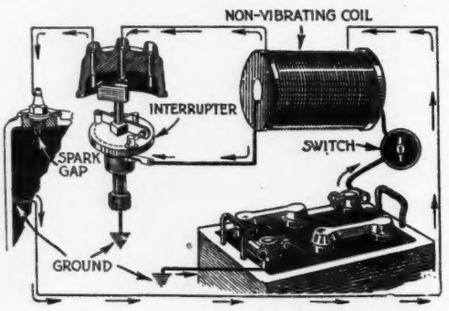
Driving in and out of frozen wheel tracks and over banks of snow subject the wheel bearings to heavy strain. Examine the bearings before using your car for the winter and replace bearings that are worn too badly to be adjusted.

The engine and cooling system lose their heat rapidly in cold air. This loss of heat must be compensated for by adjusting your carbureter for hotter mixture. The needle valve or nozzle should be opened wider to supply the extra fuel needed.

Leakage in the air inlet of the carbureter and failure of the "choke" to close the air inlet properly will give you trouble in starting your car when the engine is cold. Replace any worn or leaking parts in the air inlet and adjust the choke to close fully.

The difficulty of starting even mechanically perfect cars in winter tends to wear out the battery quickly. The generator can be adjusted to charge the battery at a higher rate. The average motorist probably will do well to have this adjustment made at a good service station. It is probably safe to say that a generator adjustment that will charge the battery at the rate of 20 amperes when driving at 30 miles an hour will be about right for the average car.

## KNOW YOUR CAR




**Your Spark Plugs**—The sparks that jump across the gap between the points, or terminals, of the spark plug are produced by a high-tension induced current in the manner shown in this diagram of a typical ignition system. Low-voltage current from the battery is led through the ignition switch to an induction coil, which "steps up" the electric voltage from six to more than 5000.

The battery current passes from battery to coil, then to interrupter, through ground and back to the battery. The high-tension current, induced by the coil, passes through the timer, across spark gap, through ground and back to the coil.

On the market are many appliances designed to aid you in starting your car in cold weather — primers, electrical heaters for the carbureter, and similar apparatus. One of my acquaintances even carries a thermos bottle filled with hot water, which he pours over the carbureter when he is ready to start his car. Most of these devices really do make starting easier, but, if you have made your car right mechanically before the winter season, you probably will not need them. Flooding the carbureter is an easy way of starting some makes of cars, but is wasteful of gasoline and tends to form carbon.

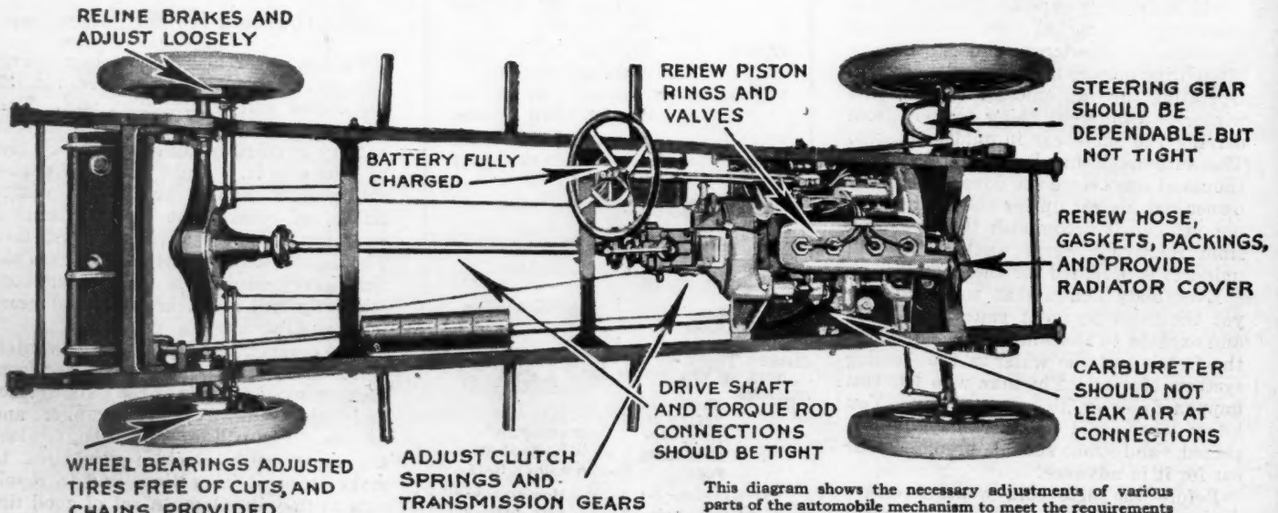
You can make starting easier for yourself by preparing for it when you stop your motor. Pull your choker rod out and open your throttle the instant you shut off the ignition. This places a heavy charge of fuel in the engine. Since the first movement of the motor adds to this charge when you press your starter pedal, the chances are that the car will start on the first turn.

## *Special Care Is Needed*

Driving and traffic conditions vary so much in different sections of the country that it would be useless for me to attempt to suggest rules of conduct to be observed on the roads during the winter. Especial care is necessary, especially when snow or ice is on the highways, reducing friction between the tires and the road. Your car cannot climb the steep grades that it ascended easily when the roads were dry; there is a tendency to skid when descending hills or making turns.

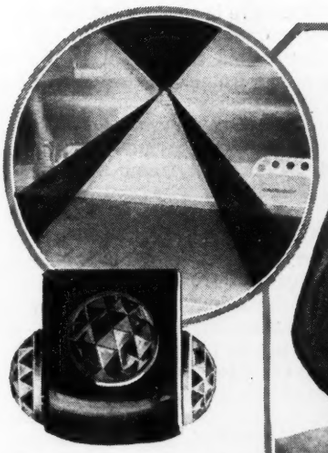
Watchfulness is necessary both on the roads and in the garage during the winter; but if you will exercise intelligent care, you can drive your car with just as much safety and enjoyment as in summer.

***ARE you planning to buy a new car this year? In making your selection don't fail to look over the new improvements in 1924 designs which will be described in next month's issue.***

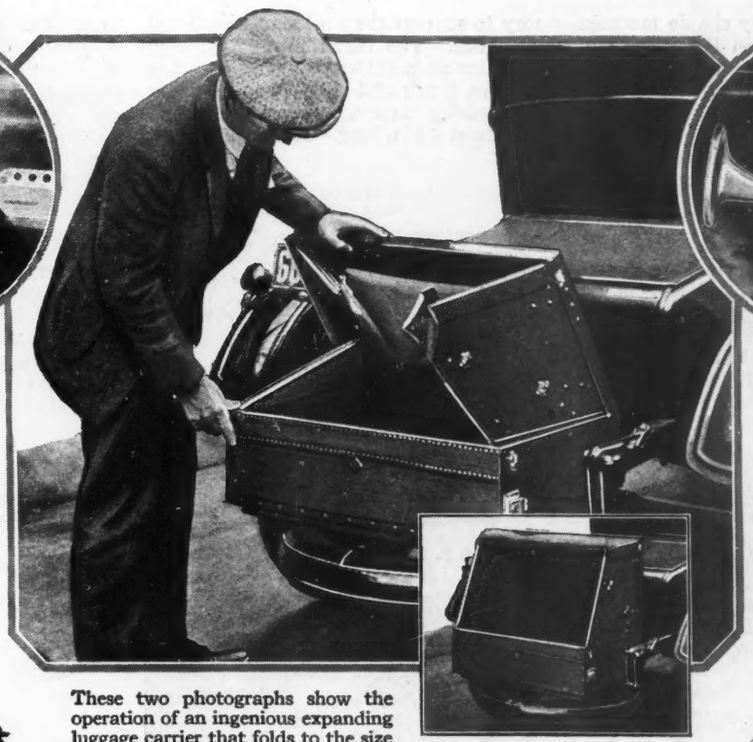

RELINE BRAKES AND ADJUST LOOSELY
RENEW PISTON RINGS AND VALVES
STEERING GEAR SHOULD BE DEPENDABLE BUT NOT TIGHT
BATTERY FULLY CHARGED
RENEW HOSE, GASKETS, PACKINGS, AND PROVIDE RADIATOR COVER
DRIVE SHAFT AND TORQUE ROD CONNECTIONS SHOULD BE TIGHT
CARBURETER SHOULD NOT LEAK AIR AT CONNECTIONS
WHEEL BEARINGS ADJUSTED TIRES FREE OF CUTS, AND CHAINS PROVIDED
ADJUST CLUTCH SPRINGS AND TRANSMISSION GEARS

This diagram shows the necessary adjustments of various parts of the automobile mechanism to meet the requirements of safe and comfortable driving during the winter months

# The Newest Aids to Better Motoring

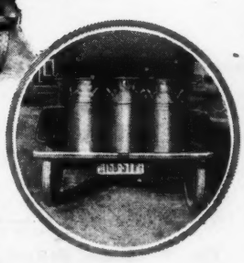


Danger of accident in entering or stepping from a car in the dark is avoided by this three-lens step lamp that illuminates the openings of both doors, the running-board and ground

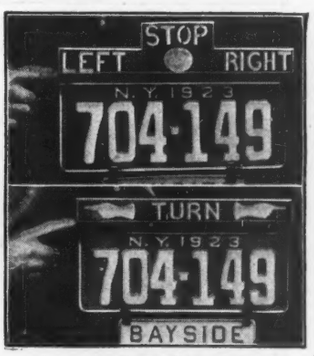


These two photographs show the operation of an ingenious expanding luggage carrier that folds to the size of a suitcase when not in use. The carrier is supported by the spare tire that swings down to a horizontal position on hinges at the rear

Valuable automobile robes or coats can be safeguarded from theft by this clamp lock. An adjustable plunger, locked by a key, causes the contact points to grip the robe like a vise



Heavy loads can be carried behind the car on this combination bumper and luggage rack designed for such uses as carrying milk to market. The rack is built of angle iron

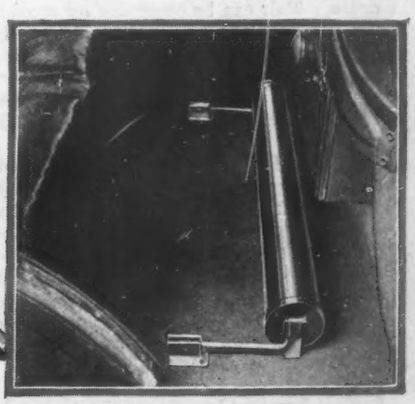



These safety light signals are controlled by a two-way switch on the dashboard. Upper picture shows rear signal; lower, front signal

This tire chain is said to be unusually effective in preventing skidding, and to be very easy on the tires

In this friction shock absorber, steel blades attached to the axle move between leaves of specially treated friction material attached to frame

This extension on the gas lever of a Ford car holds a pushbutton that makes it possible to dim the lights of the car without removing your hand from the wheel. The extension also facilitates control of the gas lever



A tubelike footrest serves as a convenient container for the tire chains. The container also may be used as a gasoline or water container

# Labor-Saving Kinks for the Autoist

BY THE relatively simple modification illustrated in Fig. 1, an auto steering wheel of the usual fixed type can be converted into a hinged or tilting wheel. This applies, however, only to a car on which the spark and gas quadrants are not mounted on the wheel. It is particularly useful in converting an old car into a sport model. The wheel spindle is cut off and slotted to form a hinge joint and an extension fastened on, as shown. This extension is threaded for a large wingnut. A key prevents the wheel from slipping.

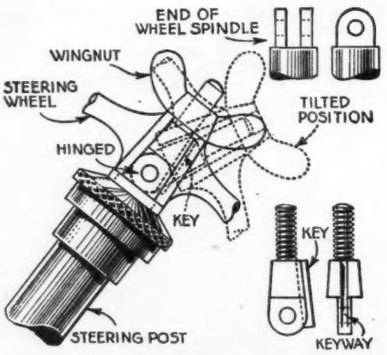



Fig. 1. Tilting steering wheel

TWO nails and a block of wood are used to make the simple tester for spark plugs shown at Fig. 2. A hole is bored near the end of the block, as indicated, and the nails are driven in at an angle so that the points will be about ⅛ in. apart. In use, one nail is touched against the terminal nut on the spark plug, while the other is placed against the metal base of the plug. —F. M. P.

Fig. 2. Spark tester

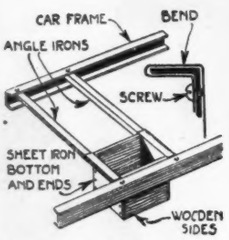



Fig. 5. Battery box

BY PURCHASING a 50-gal. drum of gasoline, the car owner can save from 2 to 5 cents a gallon. The main objection to buying gasoline this way is the difficulty of handling the drum. This can be overcome by providing two brackets, as shown in Fig. 3, to support the drum at a level corresponding to that of the delivery truck. Two rollers are set in each bracket in such a way that the drum can be rotated without difficulty.

A large filling bung is drilled, tapped, and fitted with the usual metal spigot, and, once made, this special cap is kept for each new barrel of fuel. To pour the gasoline, the drum is turned over until the spigot is in a convenient position, and afterward is rolled back with the spigot at the top, so that there will be no leakage.

Lubricating oil drums can be handled in the same way.—A. C. T.

THE homemade creeper illustrated in Fig. 4 is unusually comfortable because the upper two fifths of its bed is hinged so that it can be raised when necessary to support the workman's head and shoulders. The materials used in construction are short lengths of narrow pine flooring, a pair of 4-in. strap hinges, four ball-bearing casters, and a 5/16-in. nail rod about 40 in. long.—R. A. FRANKLIN.

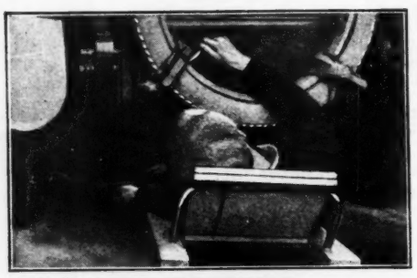


Fig. 4. An adjustable rest for the head and shoulders makes this garage creeper unusually comfortable for work under car

Fig. 7. Cheaply made radiator filler

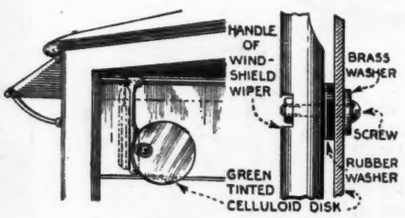



Fig. 8. Glare deflector

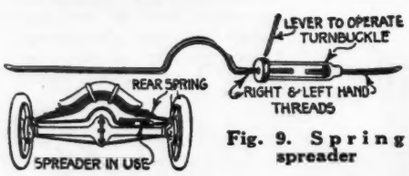



Fig. 9. Spring spreader

IN REMODELING an old style auto it is sometimes a puzzle to know where to carry the storage battery. One way is to fasten one of the many commercial battery boxes to the runningboard. Another is to place the battery under the back seat, if space allows. Perhaps the best idea is to arrange suitable brackets under the floorboards.

To fit the angle-iron supports properly to the car frame, the work should be done, if possible, at a time when the body of the car has been removed. Once the iron cross pieces are in place, as shown in Fig. 5, they cannot work loose. Note that they are bolted or riveted to the top flange of the frame. This is so that the drive-shaft tube will clear them better, but if there seems no danger of the tube's striking the irons, perhaps they can be bolted to the lower frame flange, which makes it unnecessary to remove the body.

AN IMPROVEMENT upon the hammer or punch method of cutting bolt holes in gaskets is to use a tool made by welding a ½-in. ball bearing to a length of ¼ or ⅛-in. rod (Fig. 6). When the gasket has been put in place, the ball is laid on each hole in succession and struck sharply. One blow cuts a clean hole. —B. S. R.

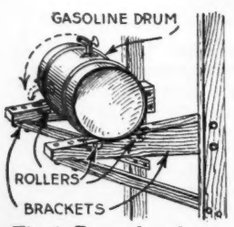



Fig. 3. Drum brackets

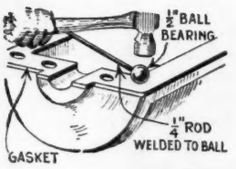


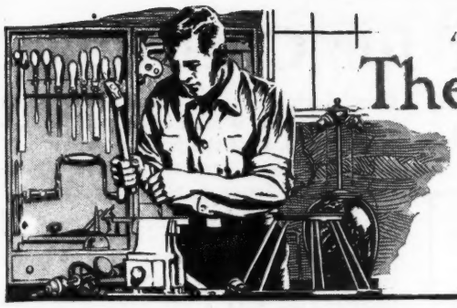

Fig. 6. Gasket punch

THE radiator filler in Fig. 7 is a real labor saver for the home garage. It is simply a 3- or 4-gal. bucket with a hole drilled or punched near the bottom. In the hole is soldered a short piece of iron pipe. This is connected by means of a length of light, flexible rubber hose about 1 ft. long with an elbow that serves as the filling nozzle. The joints are made with some hose clamps or wire.

A hook soldered to the elbow fastens over the rim of the bucket and holds the hose up when the pail is being filled or carried.—J. L.

ONE motorist uses a simple glare deflector made as shown in Fig. 8. The deflector is a green celluloid disk fastened with a small screw and washers on the inside arm of the windshield wiper. Since the wiper is arranged to move across the windshield, and the glare disk can be swung around in a circle, it is possible to place the deflector quickly in any position desired.—J. N. T.

IN ANY garage where Ford cars are overhauled, the spring spreader shown in Fig. 9 will be found to save much time when removing or placing the spring shackle bolts. Two bars, one with a U-bend, are connected with a turnbuckle and the ends are pointed to fit back of the spring eyes.—L. B. C.



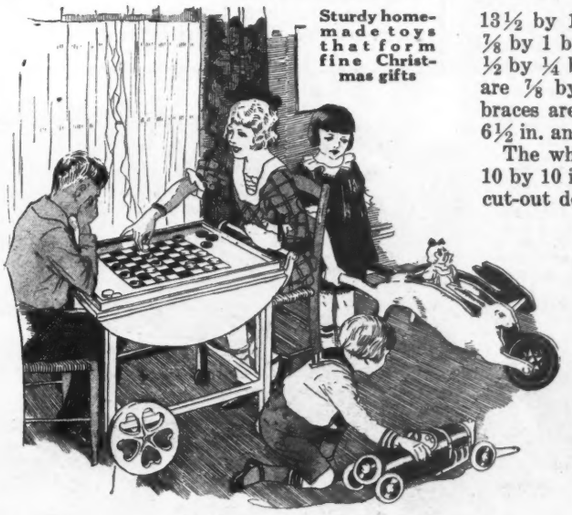
# The Home Workshop

Arthur Wakeling, Editor

## Making Toys to Delight the Kiddies

MAKING toys for the kiddies' Christmas is the most enjoyable work that comes into the home workshop. Every man who is in the least handy with tools likes to build playthings. It is fun to put them together; they always seem to turn out successfully; and they are immensely appreciated by the children.

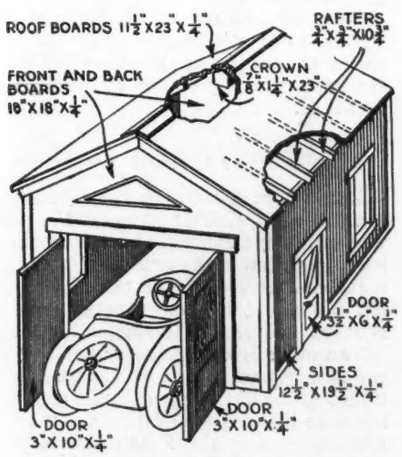
This is especially true when the toys are so interesting, sturdy, and easily constructed as those illustrated—a toy tea cart and game table, a miniature garage, and a bunny wheelbarrow. These were designed especially for POPULAR SCIENCE MONTHLY, and the working details, prepared by George F. Kaercher, are given in full in Home Workshop Blueprint No. 29.



Sturdy home-made toys that form fine Christmas gifts

Although essentially a girl's toy, the tea cart can be used by the entire family as a portable game table. On the tray—either on the face or on the back, as preferred—is painted a checkerboard. The table can be used also for many other games, and its chief advantage is that it can be wheeled about from room to room or carried up and down stairs.

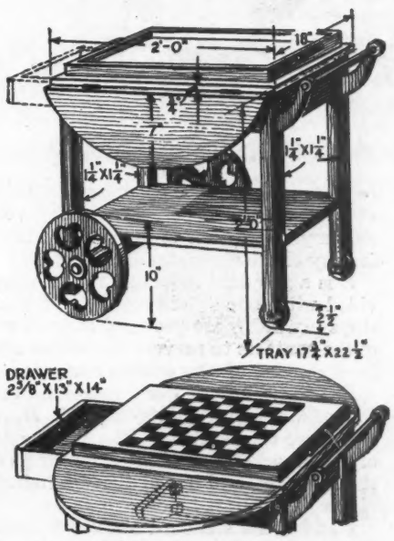
The tea wagon can be made of whitewood, pine, cypress, or any other wood that is easily worked. It is 18 in. wide,




This large toy garage is built of wooden strips covered with wallboard

2 ft. long, and stands 2 ft. high. The table top is ¾ by 18 by 24 in.; and the drop leaves are cut from pieces ¾ by 7 by 24 in. The back posts are 1¼ by 1¼ by 21½ in., and the front posts are the same stock, but only 17 in. long.

The main top rests on a mitered frame




Although a girl's toy, this tea cart can be used by the whole family for games

made of two pieces ¾ by 2¼ by 22½ in., and two pieces ¾ by 2¼ by 16½ in. The lower shelf is ⅞ by 15¾ by 21¾ in., but it is just as well to use 1⅛-in. stock, if it is at hand. The heavy shelf reinforces the construction, and it is essential in building toys always to make the parts as strong as possible.

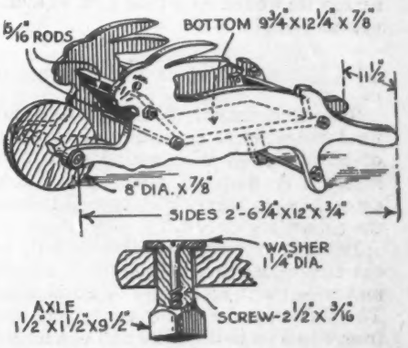
The top side rails are ⅞ by 3½ by 20½ in., and one end rail is ⅞ by 2⅝ by 13 in. The drawer front is the same size as the end rail. The sides of the drawer are ½ by 2⅝ by 14 in., the back ½ by 1⅞ by 12½ in., and the bottom ¼ by 13½ by 12½ in. The two runners are ⅞ by 1 by 19⅞ in., and the two guides, ½ by ¼ by 14 in. The two drawer rails are ⅞ by 2 by 13 in. The table leaf braces are cut from pieces ⅝ by 4¾ by 6½ in. and are hinged to the side rails.

The wheels are cut from pieces ⅞ by 10 by 10 in. They can be lightened by a cut-out design, as shown, or they can be left solid. Baby carriage or toy express wagon wheels, or any other kind of small wheels can be used, if at hand. The front axle is 1½ by 1½ by 19 in. The small back wheels are cut from pieces ¾ by 2½ by 2½ in., and turn on wooden pins 1¼ in. long and ¾ in. in diameter.

The two handle brackets are cut from one piece ⅞ by 6 by 9 in. A ⅝-in. dowel 15½ in. long is used for the handle bar. The tray bottom is ⅝ by 16¾ by 21½ in. with sides ½ by 1⅜ in. mitered round.

Two washers for the front wheels, one drawer knob, two drawer stops ½ by ½ by 1 in., two tray handles 9/16 by ⅝ by 3½ in., rubber or felt tray feet, screws, nails, and brads are also needed.

Mortise and tenon and doweled construction is preferable because of its strength, but the parts can be nailed or screwed together with much less work. Small angle irons, mending plates and box corners can be used to advantage in strengthening toy furniture of this type,




The bunny wheelbarrow makes a certain hit with the younger children

when the joints are merely nailed or screwed together.

The simplest method of finishing the tea wagon is to give it one or two coats of enamel undercoating, or flat white paint, and one or more coats of enamel. It is advisable to use only the best materials in

(Turn to page 107)

# How to Make a Radio Set for Christmas

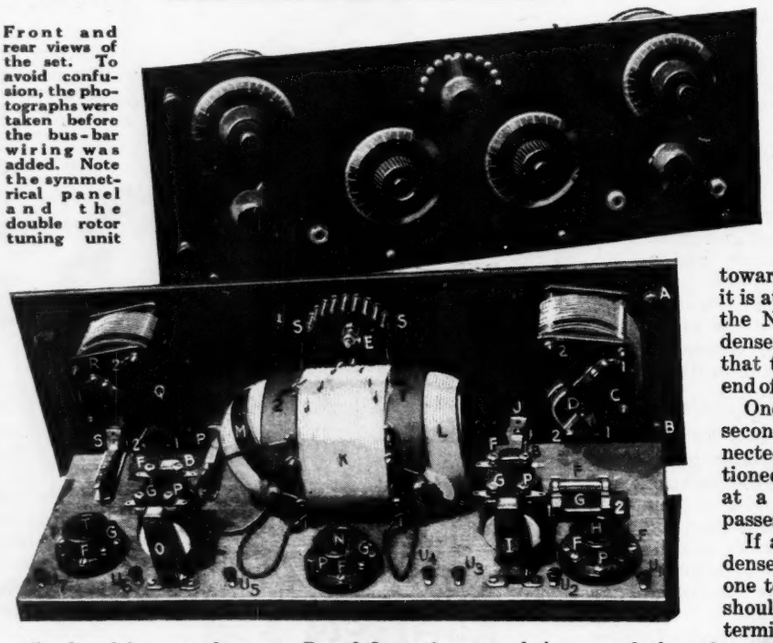
By Joseph Calcaterra

*Of POPULAR SCIENCE MONTHLY'S Radio Staff*

**CHRISTMAS is the high-water mark of the broadcasting season. Operas, concerts, plays, vaudeville turns, dance music, lectures, sports — every imaginable form of entertainment is then "in the air." You can enjoy it all if you assemble this exceptionally fine two-stage tickler coil feedback receiver designed by Mr. Calcaterra as the ideal Christmas set.**

NOTHING could be more in keeping with the Christmas spirit this year than the presentation to the household of a good, reliable radio set. The joy that such a gift will bring to every one in the family is certain to be lasting. The radio set offers a solution to the question, "How can we make evenings at home enjoyable enough to compete with the club and the movies?"

For ease of construction, simplicity of operation, and general all-around efficiency the double-rotor type of tuning unit has few rivals. Why it has not enjoyed greater popularity is hard to understand. A tuner of this type is the heart of the two-stage receiving set illustrated. A rear view of the unit is shown in the photograph of the back of the set; the front view is illustrated in connection with Jack Binns' article on page 59.



Front and rear views of the set. To avoid confusion, the photographs were taken before the bus-bar wiring was added. Note the symmetrical panel and the double rotor tuning unit

Two rotors, one at each end of the stator tube, are used. The secondary coil of the circuit is wound on one rotor while the tickler coil, used to provide regeneration, is wound on the other rotor.

Taking into consideration the selective features of double circuit tuning, combined with the great signal strength obtained by regeneration, the receiver described this month is one of the most compact and efficient it is possible to construct.

The circuit provides for three coils, a primary, a secondary, and a tickler coil, placed in inductive relation with each other. The primary coil consists of 63 turns tapped at every seven turns, with a 23-plate condenser placed across the coil to provide closer tuning. The coil is made of No. 20 s.c.c. wire wound on a tube 4 in. in diameter and 4½ in. long.

## *A Condenser Tunes the Secondary*

The secondary and tickler coils are fixed inductances consisting of 50 turns of No. 24 s.c.c. wire wound on 3½-in. rotors. A 23-plate condenser, placed across the secondary coil, is used to tune the secondary circuit.

It is not necessary to adhere strictly to the dimensions given if the tubes, rotors, and wire mentioned are not obtainable. The stator can be of any convenient size from 3 to 4 in. in diameter and of a length ½ in. greater than the diameter of the rotors that are to be used. The diameter of the rotors can be from ½ to 1 in. less than the outside diameter of the stator tube. The wire used can vary from No. 20 to No. 26 single or double cotton covered and the number of turns used on the rotors can vary from 30 to 50.

In the illustration, *A* and *B* are the aerial and ground posts respectively. *C* and *R* are 23-plate Vernier variable condensers. *D* and *Q* are rheostats, being of 30 ohms resistance for the new 3-volt, .06 ampere tubes or of 6 ohms resistance for any of the other standard tubes.

*E* is a standard inductance switch provided with nine switch contacts. Switch stops marked *S* are provided at each end of the contacts to prevent the switch arm from slipping off the outside contacts.

*F* is a grid leak of 1 or 2 megohms, and *G*, a grid condenser of .00025 mfd. *H*, *N*, and *T* are tube sockets. The *G* terminal of the *H* socket, one of the *F* terminals of the *N* socket, and one of the *F* terminals of the *T* socket are hidden from view.

*I* and *O* are standard audio frequency transformers. *I* may be a high ratio transformer, but *O* should be a low ratio one. *J* and *P* are double-circuit jacks, while *S* is a single-circuit jack.

*K* is the primary winding; *L* the tickler winding, and *M* the secondary winding.

$U_1$, $U_2$, $U_3$, $U_4$, $U_5$, $U_6$, and $U_7$ are binding posts used for battery connections.

The general location of the instruments on the panel and baseboard is clearly shown on the photographs. The size of the panel is 18 by 7 by 3/16 in. The baseboard is 17 by 6½ by ⅞ in. The thickness of the baseboard is not important.

No difficulty in making the proper connections will be experienced if the directions given below are followed carefully:

A single wire is used to connect the beginning, No. 1, of the primary winding *K* with the No. 2 or stationary plate terminal of condenser *C* and the aerial post *A*. Another wire is used to connect the ground post *B* with the No. 1 or rotary plate terminal of condenser *C*. The No. 1 terminal of the condenser is then connected with arm *E* of the inductance switch by a flexible wire connection.

Now connect each tap of the primary winding *K*, beginning at the first tap from the beginning or No. 1 end of the winding with its respective switch contact. The end of the winding, marked No. 2, is used as a tap and connected with the last switch point of the inductance switch.

Connect the No. 1 terminal of grid condenser *G* with the *G* terminal of socket *H*. Then connect one end of a wire with the No. 2 terminal of the grid condenser; lead the wire straight up toward the top of the set until it is at a height on a line with the No. 2 terminal of condenser *R;* and bend it toward that terminal and fasten the end of the wire to the terminal.

One of the leads of the secondary coil *M* is then connected with the wire mentioned in the last paragraph at a point where the wire passes over the rotor shaft.

If a combination grid condenser and leak is not used, one terminal of the grid leak should be connected with one terminal of the grid condenser and the other terminal of the grid leak connected with the other terminal of the grid condenser.

Next connect one of the leads of the tickler rotor winding *L* with the top spring of jack *J* and the other lead from the same winding to the *P* terminal of socket *H*.

## *Wiring the Filament Terminals*

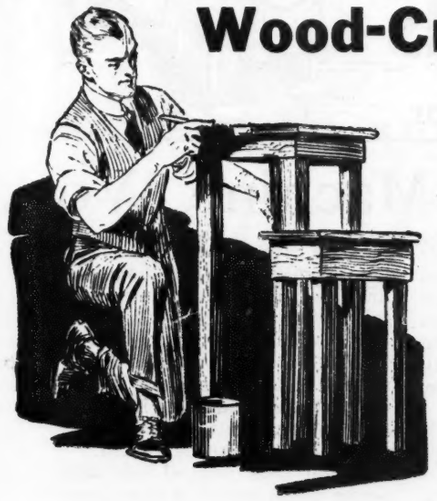
Run a wire connecting one *F* terminal of each socket with binding post $U_2$. The wire can be run along the back edge of the baseboard, but make sure that it cannot make contact with any of the other binding posts. If bus-bar wire is used, it should be covered with spaghetti tubing.

The other lead from rotor winding *M* can now be connected with the wire mentioned in the last paragraph, the connecting wire being run directly back to the wire connecting the *F* terminals of the sockets or to the *F* terminal of socket *N*, to which the wire mentioned in the preceding paragraph is connected.

A wire is then used to connect the No. 1 terminal of condenser *R* with the *F* terminal of socket *T* to which the wire connecting one of the F terminals of each socket with binding post $U_2$ is connected. An insulated wire, bared only at the

(*Turn to page 126*)

# How You Can Give a Beautiful Finish To Wood-Craft Presents



Small odd pieces of modern furniture make welcome Christmas presents for the home. You yourself can easily make them for your family. There is no particular trick to constructing porch swings, tables, telephone sets, etc.

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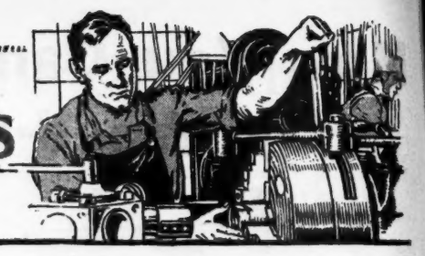
# Better Shop Methods

## How Expert Mechanics Save Time and Labor



# Short Cuts in Laying Out Machine Work

By Joe V. Romig
*Tool Designer and Builder*

MANY short cuts are possible in laying or lining out work in the machine shop. Presumably the regular layer-out and the shop foreman know most of them, but the machine hand or floor hand, no matter how much experience he has had in his particular specialty, often runs into all sorts of difficulties when he is called upon to lay out work.

It goes without saying that any mechanic who attempts lining out for other workmen must be familiar with the use of machine tools in general and have been "through the mill" sufficiently to know just what operations are necessary and their proper order to complete the work in hand.

The main problems in laying out are these: To mark and check the work accurately and speedily, and to do it in such a way that the machinists will be able to follow through the various steps without themselves having to check and measure for obscure markings, uncertain checking points, and unindicated fly lines.

The layer-out can, indeed, do much to simplify the work of the machinist. First of all, the lines and punch marks should be easily distinguishable. On rough work this can be accomplished by coating the metal with a whitewash composed of equal parts of lime and powdered chalk mixed with water to a thin paste and spread over the work with a soft bristle brush.

On extremely accurate and highly polished tool work, it is more desirable to give the surfaces a coating of copper. This is done by applying a solution of blue vitriol and distilled water, care being taken first to remove all grease and dirt. The copper is easily removed after the completion of the work by rubbing the surface with fine emery paper or cloth.

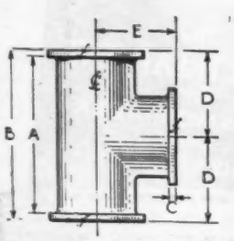



Fig. 2. Diagram illustrating layout of flanged casting

For laying out, the machinist should become accustomed to having a particular set of tools available at his bench so that he will not have to search through his tool chest after he has started. There should be light and medium weight hammers, dividers from 4 to 12 in., micrometers, trammel sets suitable for both small and large diameter work, with suitable divider and caliper feet and also a set of ball feet for work with holes in the center, and a surface gage. Then, too, he should have at hand an accurate tape line, several scales of different lengths, scribers, prick punches, squares, and a bevel protractor, as well as a center head and other tools.

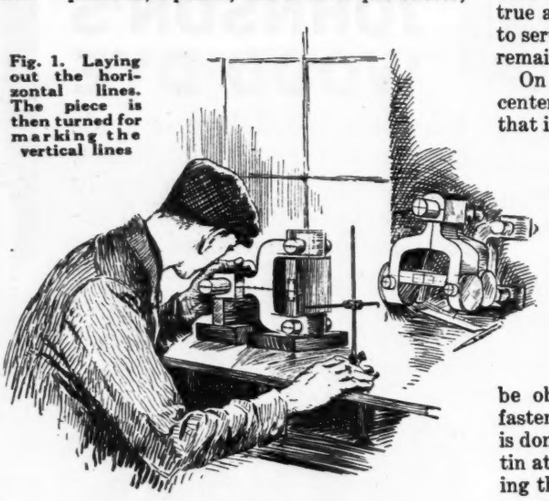


Fig. 1. Laying out the horizontal lines. The piece is then turned for marking the vertical lines

In all laying out, the surface plate plays a most important part. On it the work must be blocked up perfectly true and level.

A careful study of the blueprints must be made and the rough dimensions of the work checked to see that no great discrepancy exists. If any part of the casting or forging is scant of metal, the lining out must be very true to save the stock. Often when the casting or forging is faulty on one side, the lining out should be such as to take off as much metal on the faulty side as possible.

### *Surfacing Cut Sometimes Necessary*

In iron castings, where there is plenty of stock for finishing but the metal appears to have air holes, it is well to have a surfacing cut made first to show how deep the defects are.

Since the starting points in laying out a piece of work are the under side of flanges, the outside of bodies, and other surfaces that are not to be machined, these should be checked carefully and all differences should be divided so as to make uniform the thickness of flanges and other parts. Thus in Fig. 2 the dimension *A* is first checked and established so that the flanges at the extremities of *B* will be equal.

Then comes the determination of all center lines. The master horizontal center line is scribed all around the work with a gage. If there are a number of bosses, lugs or flat surfaces to be worked to accurate distances from the master center line, their distances are scribed horizontally before turning the work, as in Fig. 1.

The work is next turned so that the master center line runs vertically to the surface plate. The work is blocked up true as before and a line is scribed across to serve as a reference line from which the remaining lines can be located.

On all lines marked out make light center punch marks at short intervals so that if the lines are rubbed out, the punch marks will serve instead. Center punches, it might be added, should be long and slender at the pointed end so that they will not obstruct the view of the lines that are being punched.

When a hollow casting is to be machined, it is customary to insert a wooden plug and scribe arcs on it from the edges to mark the center. A clearer intersection can be obtained if a square piece of tin is fastened to the plug at the center. This is done by bending over two corners of the tin at right angles to the surface and driving these points into the soft wood. The arcs on the tin will be more clearly defined than on wood.

From the center thus established it is possible to run a fly line; in fact, any experienced shop foreman will insist that all machine workers run a fly line on every piece they have to turn. This facilitates the progress of the work after it leaves their hands. It requires but a minute extra when the work is still in the lathe, but saves much time later, as well as insuring greater accuracy. When in the lathe the line *A* is cut with a fine pointed tool as shown in Fig. 3.

Referring to Fig. 2, the distance *E* is projected from the previously established center line. Then the distances *D* are laid out, giving the center line of the side flange. Such dimensions as *C*, the thickness of the single flange, are neglected entirely when both surfaces of the flange do not require machining. While the piece above described is a simple one, it serves

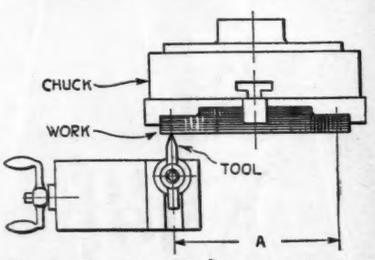



Fig. 3. Running a fly line on a circular piece of work in the lathe with a fine pointed tool

(*Turn to page 84*)

# Choose your "mike" CAREFULLY

IF there's one tool in your kit that should be *right in every detail* it's the Micrometer.

Get a Starrett and you can't go wrong. Here are some of the features that help to explain the preference of two generations of machinists for these fine Micrometers.

EASILY READ—*notice the large Barrel and the clear-cut distinct graduations.*

SLEEVE ADJUSTMENT—*a recognized triumph in tool design. Easier and more exact than the usual anvil adjustment.*

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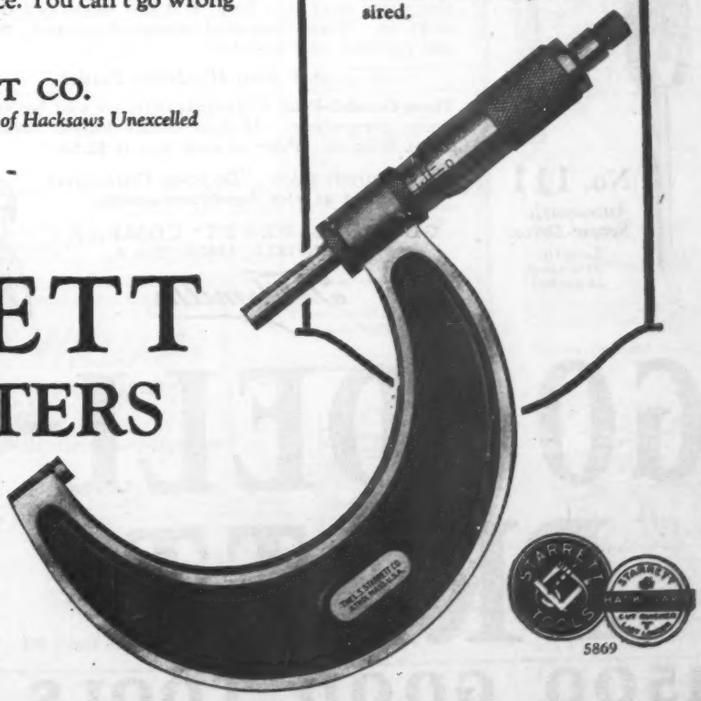

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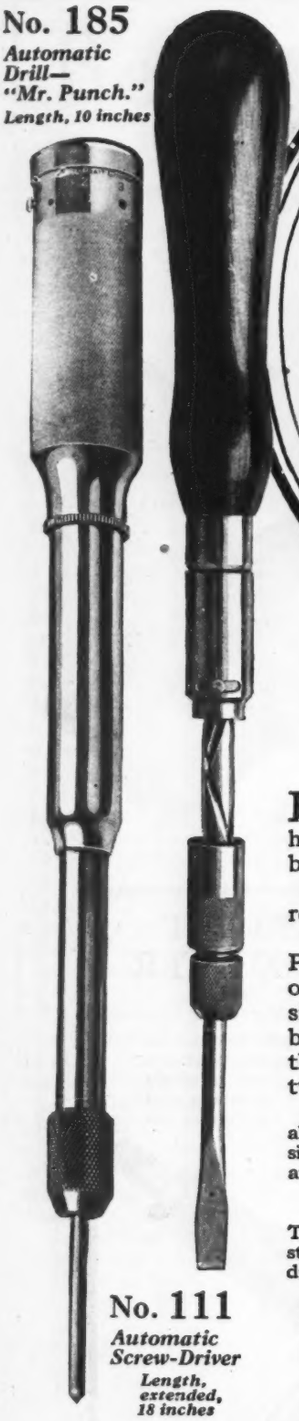

No. 185
*Automatic Drill— "Mr. Punch."*
*Length, 10 inches*

# Give him a tool for Christmas

HERE are two of the best tools made—for handy men, for men who work with tools, for boys who build things.

Each is packed in a Special Gift Box—all ready to present on Christmas morning.

The Goodell-Pratt Automatic Drill, "Mr. Punch," bores holes—any size from 1/16 to 11/64 of an inch. In the handle are eight different size drill points. You get the one you want by turning the top cap. Fit the point into the chuck. Then you push and Mr. Punch twists. The hole is made in a jiffy.

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GOODELL-PRATT COMPANY
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*Toolsmiths*

# GOODELL-PRATT

## 1500 GOOD TOOLS


## Laying Out Machine Work

(*Continued from page 82*)

to show the sequence in which the operations of laying-out are to be performed.

In general it may be stated that individual parts are usually laid out complete in themselves. When many pieces are to be made alike, a templet is commonly used and the work is done in jigs and fixtures that are themselves laid out to conform to the templet. The templets are made of thin sheet plate.

When locating points on the circumference of the fly line, it is often found that an accumulation of errors caused by the slipping of the divider points and the springing of the legs gives an appreciable difference in location. In fact, if an attempt at division is made by spacing around the circle with consecutive positions of the dividers, no two measurements will agree exactly, even though the workman may use extreme care. The better way is to divide the circumference into fours with two lines at right angles through the center and then re-divide into eighths and sixteenths in the same way until the proper locations are arrived at. Often this will not give the proper number of divisions and the start must be with sixths. This can be accomplished by using the radius as a chord on the dividers for dividing into sixths and proceeding as before. A table of chords is given in most handbooks and will be found invaluable in obtaining accurate results.

Disks of lead are sometimes used to plug holes so that the center can be marked for scribing lines with the dividers. The disks can be compressed or stretched to fit.

### *Marking Holes for Drilling*

Holes that are to be drilled are often laid out with two or three circles inside the drill size circle. These circles are punched at several places, as the oil used on the drill dims the scribed lines. The advantage of the extra circles is in showing if the drill is running out before it has cut to its full diameter. If it is running out, it can be coaxed back by means of a chisel.

Many machinists find difficulty when it comes to lining out large work, for then the piece must be leveled up on an accurate surface plate and a level must, in part, take the place of the square. Be sure that the surface plate is not misused. Moreover, the plate itself should be carefully leveled.

Plumb bobs are used to level up clumsy work. Cylindrical work is first centered and all other points are squared or leveled from these centers. After this the plumb bob is used to transfer the center to the opposite face. When using a long straight edge to transfer through the plumb bob to a lower surface, it is good practice to clamp it to the upper flanges. Any straight edge or square is liable to move unless it is clamped in a true and accurate position.

Rather than project an angle from a small bevel protractor with a scale or straight edge held against the leg, lay out the bevel on a circle and divide a quarter

(*Turn to page 86*)

# NEW — INDISPENSABLE!

This Household Guide enables you to select the right Paint, Varnish, Stain or Enamel for a given purpose. Don't take chances.

**Save this Page** *for reference with your family, your painter and the Sherwin-Williams dealer.*

To protect its beauty

To "insure" your roof

To keep linoleum like new

To properly finish woodwork

To keep attractive

To enrich hard wood

## HOUSEHOLD GUIDE

**For Painting, Varnishing, Staining and Enameling**

***IMPORTANT:*** *Each of the products specified below bears our name and trade mark*

TRADE MARK

| | TO PAINT *Use product named below* | TO VARNISH *Use product named below* | TO STAIN *Use product named below* | TO ENAMEL *Use product named below* |
|---|---|---|---|---|
| AUTOMOBILES | *S-W Auto Enamel:* for the man who paints his own car | *S-W Auto Enamel Clear:* a colorless varnish | | *S-W Auto Enamel:* assorted colors |
| AUTOMOBILE TOPS AND SEATS | *S-W Auto Top and S-W Auto Seat Dressing* | | | |
| BRICK | *SWP House Paint:* a full oil gloss<br>*S-W Concrete Wall Finish:* dull finish | | | *Old Dutch Enamel:* full gloss for outside exposure |
| CEILINGS, Interior | *Flat-Tone:* the washable, flat oil paint | *Scar-Not Varnish:* for woodwork only; such as beamed ceilings, etc. | *S-W Handcraft Stain:* Penetrating spirit stain for new hard wood<br>*Floorlac:* varnish and stain combined, new or old wood | *Enameloid:* assorted colors |
| Exterior | *SWP House Paint:* | *Rexpar Varnish:* weather resisting, for porch ceilings, etc. | *S-W Oil Stain:* for new wood | *Old Dutch Enamel:* white, gray, ivory, gloss or rubbed effect |
| CONCRETE | *S-W Concrete Wall Finish:* a paint, resists weather | | | |
| DOORS, Interior | *SWP House Paint:* | *Scar-Not Varnish:* gloss<br>*Velvet Finish Varnish No. 1044:* dries to a dull finish without rubbing | *Floorlac:* a varnish and stain combined<br>*S-W Handcraft Stain:* penetrating spirit stain for new wood only | *Enameloid:* assorted colors |
| Exterior | *SWP House Paint:* | *Rexpar Varnish:* weather resisting spar varnish | *S-W Oil Stain:* for new wood | *Old Dutch Enamel:* white, gray, ivory. For interior and exterior use |
| FENCES | *SWP House Paint:*<br>*Metalastic* (iron or wire only)<br>*S-W Roof and Bridge Paint:* for rough work | | *S-W Preservative Shingle Stain* | |
| FLOORS, Interior (wood) | *S-W Inside Floor Paint:* stands repeated scrubbing | *Mar-Not Varnish:* water resisting, heel-proof | *Floorlac:* a varnish and stain combined | *S-W Inside Floor Paint:* the enamel-like finish |
| Concrete | *S-W Concrete Floor Finish:* wears well; washes well | | | *S-W Concrete Floor Finish:* high-gloss; durable |
| Porch | *S-W Porch and Deck Paint:* | | | |
| FURNITURE, Indoors | *Enameloid:* the decorative enamel | *Scar-Not Varnish:* stands hard usage | *Floorlac:* a varnish and stain combined | *Old Dutch Enamel:* white, gray, ivory, gloss or rubbed effect |
| Porch | *Enameloid:* assorted colors | *Rexpar Varnish:* weather resisting | *S-W Oil Stain:* for new wood | *Enameloid:* assorted colors |
| HOUSE OR GARAGE Exterior | *SWP House Paint:* | *Rexpar Varnish:* weather resisting | *S-W Preservative Shingle Stain:* | *Old Dutch Enamel:* enduring gloss |
| LINOLEUM | *S-W Inside Floor Paint:* stands repeated scrubbing | *Mar-Not Varnish:* protects the pattern | | *S-W Inside Floor Paint:* the enamel-like finish |
| RADIATORS | *Flat-Tone:* flat oil paint<br>*S-W Aluminum or Gold Paint* | | | *Enameloid:* assorted colors |
| ROOFS, Shingle<br>Metal<br>Composition | *S-W Roof and Bridge Paint:*<br>*Metalastic:*<br>*Ebonol:* black coal tar paint | | *S-W Preservative Shingle Stain:* | |
| SCREENS | *S-W Screen Enamel:* | | | *S-W Screen Enamel* |
| TOYS | *S-W Family Paint:* assorted color | *Rexpar Varnish:* | *Floorlac:* (inside use) a varnish and stain combined | *Enameloid:* assorted colors |
| WALLS, Interior (Plaster or Wallboard) | *Flat-Tone:* the washable, flat oil paint<br>*SWP House Paint:* a full oil gloss | | | *Old Dutch Enamel:* white, gray, ivory; gloss or rubbed effect<br>*Enameloid:* assorted colors |
| WOODWORK, Interior | *SWP House Paint:* gloss<br>*Flat-Tone:* flat oil paint | *Scar-Not Varnish:* high gloss but can be rubbed to a dull finish<br>*Velvet Finish Varnish No. 1044:* dries dull without rubbing | *S-W Handcraft Stain:* penetrating spirit stain for new hardwood<br>*S-W Oil Stain:* for new soft wood<br>*Floorlac:* for new or old wood; a varnish and stain combined | *Old Dutch Enamel:* white, gray, ivory; dull or gloss; aristocrat of enamels, specified by leading architects<br>*Enameloid:* assorted colors |

NOTE: *Best results can be had by following the carefully prepared directions on labels.*

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**SHERWIN-WILLIAMS PAINTS AND VARNISHES** — COVER THE EARTH

To "renew" your car

Mark on the "Household Guide" the particular surface or article you have in mind to finish. The Guide covers the more common problems. If you have some painting, varnishing, enameling or staining problems in your house, not covered by the Guide, write us. A more extensive Guide will be found at the store of your Sherwin-Williams dealer—prominently displayed—a part of his service.

Write for free booklet B450 with complete Household Guide and helpful information on all painting, varnishing, staining and enameling. Valuable whether you do the work yourself or employ a master painter.

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**THE SHERWIN-WILLIAMS CO., 601 Canal Rd., Cleveland, Ohio**

For cheerful, satisfactory walls

For permanence and beauty

# Crossroads of Conversation

Could the telephone directory in the hands of each subscriber be revised from hour to hour, there would be no need for the information operator. But even during its printing and binding, thousands of changes take place in the telephone community. New subscribers are added to the list. Old ones move their places of business or of residence.

Though their names are not listed on the directory, these subscribers must be connected by the highways of speech with all others in the community. To supplement the printed page, there must be guides at the crossroads of conversation.

Such are the information operators, selected for their task because of quickness and accuracy, courtesy and intelligence. At their desks, connected with the switchboards in central offices, they relieve the regular operators from answering thousands of questions about telephone numbers that would otherwise impede the rendering of service. If they are unnecessarily asked for numbers already in the directory, service is retarded.

"Information" stands for the most complete utilization of telephone facilities.

"BELL SYSTEM"
AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
*One Policy, One System, Universal Service, and all directed toward Better Service*

**Save Your Tools *and* Save Money!**

A place for every Tool and every Tool in a GERSTNER Case will save both money and Tools. A style, size and price to suit all trades. Catalog free.

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**$3 Cash Buys Typewriter**

**Balance Only $5 Monthly**

Save 35 to 60% on all standard makes—Underwood, Royal, Remington, etc. Every machine thoroughly rebuilt and GUARANTEED. Try five days at our expense before you buy.

WRITE at once for Free Descriptive Circular and Special Low Prices.

5 DAYS FREE TRIAL

Wynn Typewriter Exchange 21 Reliance Bldg. Kansas City, Mo.

**WORK FOR UNCLE SAM**

**"The best employer in the world"**

Wonderful opportunity for men and women. Thousands of appointments yearly. Good salaries, short hours, liberal vacations. Positions open now in every city of the country and in Alaska, Porto Rico, Hawaii and the Philippines. Write for FREE CIVIL SERVICE BOOKLET, which tells how to get a position with the U. S. Government.

INTERNATIONAL CORRESPONDENCE SCHOOLS Box 7667-C Scranton, Penna.

## Laying Out Machine Work

(*Continued from page 84*)

segment into the number of spaces necessary to give the bevel required.

Be careful when studying a print to get the right side of any angular work and ascertain whether the angular position is taken from the vertical or horizontal.

The first line scribed with a center head should be checked by reversing the head and scribing another line through it. If the head is off or the scale is loose or out of true, a double line will show. The same is true of lines drawn with a square.

Parallel lines drawn with other than surface gages or height gages should be projected by swinging arcs from the first line. Finally recheck all layouts with the utmost care.

## Water Still Cheaply Made for Auto Repair Shops

A WATER still is a necessity in auto repair shops and often a convenience in the home. A simple and yet efficient still can be made and used in any place where a source of low-pressure steam can be obtained; in other places the hot-water tanks can be converted into steam generators with but slight alterations.

In the latter case a steam line is inserted in the top of the water tank with a low-pressure steam gage and a safety valve that will blow off at 10 pounds. The water is kept below the

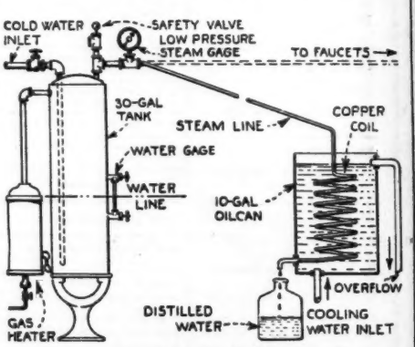



**Diagram showing a typical installation using steam from hot-water boiler**

line shown in the illustration, its level being indicated on the water gage at the side.

The still itself consists of a 10-gal. oilcan with the top removed and a copper coil. The steam is led through the coil, where it condenses and the distilled water flows out of the end of the coil, which projects from the tank near the bottom. Cooling water is led into the bottom of the tank and an overflow pipe is soldered to the tank near the top.

Any source of low-pressure steam will work well. Steam-heating systems and steam-pressure cookers properly equipped with valves and gages may safely be used in conjunction with this still.—JOHN H. SCHALEK, Pittsburgh, Pa.

IN THE absence of borax, powdered glass makes an excellent flux for brazing. Heat the glass to redness, drop into cold water, and pulverize.

**Type RB-2** **Price $135.00**

# *Announcing a New Paragon Receiver*

## —the Ideal Family Christmas Gift

What could be a more wonderful Christmas gift than a radio receiving set that you *know* is the best that money can buy? Think of the pleasure it will bring to every member of the family, young and old. Think of the happiness it will mean to you every night of the year.

PARAGON Radio Receivers are famous as the three circuit pioneers which have proved their superiority by eight years of practical operation.

The newest PARAGON, pictured above, is the last word in sensitivity and selectivity. The superiority of this type over all other classes of receiving equipment has been thoroughly proved by the long list of distance records which it holds. Included in these records are the reception of the first trans-continental amateur message, the reception of the first trans-Atlantic message, and the unbroken communication which it has maintained with the McMillan Expedition frozen in above the Arctic Circle.

The operation of the new PARAGON receiver is so materially simplified that even in the hands of a novice it equals in every way the performance of the older type in the hands of an expert.

You need only switch on the tubes, set the calibrated dial and turn two other dials that automatically give you their proper position for the reception of any given broadcasting station.

In appearance it is an addition to any home. All cabinet work is of mahogany with a brown mahogany finish. All metal parts showing, inside as well as outside of the cabinet, are nickel plated. 98% of the wiring is invisible. The whole outfit is compact, neat, solidly built, and finely finished. It is the ideal Radio receiver and the ideal holiday gift.

**An illustrated Catalog of Paragon Radio Products is yours for the asking.**

***Dealers:*** **We believe in the proper distribution of Paragon Radio Products. Our Exclusive Distributors are particularly interested in territorially protected dealers, who will concentrate, solicit and serve the consumer in the sale of Paragon Radio Receivers. If interested, write us for details.**

**ADAMS-MORGAN CO., 18 Alvin Avenue, Upper Montclair, N. J.**

# PARAGON

Reg. U. S. Pat. Off.

## *RADIO PRODUCTS*

# Another Addition to our Ratchet Screw Driver Line No. 59

YOU hear people say, "I can't seem to find a ratchet screw driver strong enough for the kind of work I do." Maybe you've said it yourself. If so, don't waste time. Stop in at the nearest hardware store and ask the man behind the counter to show you this new Millers Falls Ratchet Screw Driver No. 59.

It is made especially for electricians, gunsmiths, mechanics and others whose work demands a screw driver more rugged than the regular type.

Same design as our popular No. 63 line of ratchet screw drivers. Your kit isn't complete without this tool. The more you use it, the better you'll like it.

***Specifications:***

Ratchet Pawls—Tool Steel.
Ratchet frame—cold rolled steel.
Handle—hardwood, highly polished. Shaped to hand. Thumb rest at lower end.
Diameter of ratchet—⅞ in.
Length of blade—1⅜ in.
Ratchet springs—spring steel.
Blade—highest quality screw driver steel, hardened and tempered.
Exposed metal parts polished and nickel plated.
Diameter of blade—⅛ in. Cabinet type.
Length overall—6¼ in.

*Ratchet operates either to right or left by turning shifter ring. At 0 it becomes a solid screw driver.*

MILLERS FALLS COMPANY
Millers Falls, Mass.
*Manufacturers of Carpenters' Tools, Hack Saws and Automobile Tools*

MILLERS FALLS TOOLS SINCE 1868


# Tilting Table for Milling Tapers

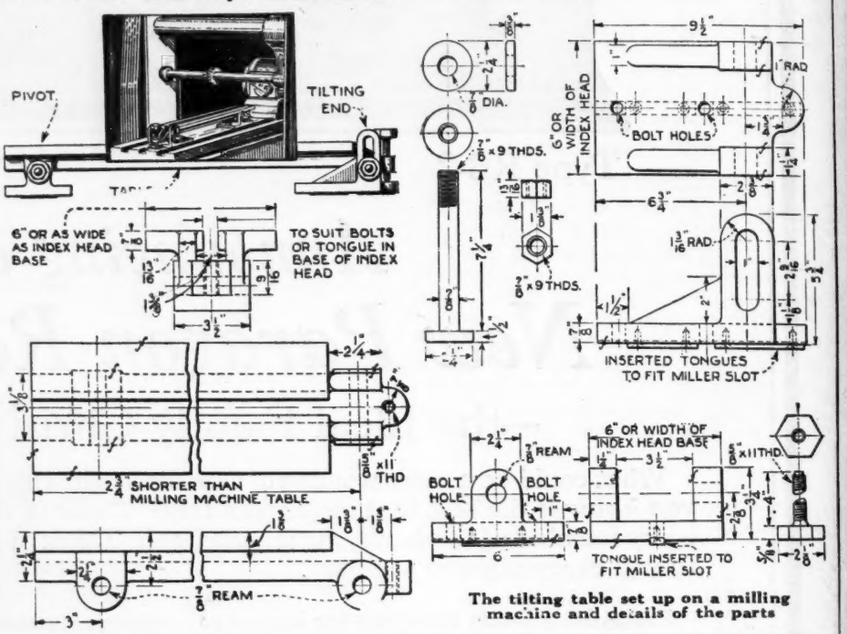
By Henry S. Laraby

AS THE milling machine has no arrangement by which the table can be thrown out of the horizontal, it is often useful to have a special tilting table for tapered work, such as taps, reamers, and the like.

The table should be as wide as the index centers with which it is to be used. By bolting irons to the table, all kinds of tapered work can be done. The angle of tilt is determined accurately by means of a sine bar. If the taper wanted is out of range of the elevating screw, one side of the table can be blocked up.

The edge of the table has been left clear of the rib usually found on tilting tables; this makes it easier to clamp work to it. Another improvement is the finishing of the under edges parallel to the top.

While the table shown here is made with castings, smaller tables are made of machine steel.




**The tilting table set up on a milling machine and details of the parts**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**FREE 10-Piece White Enameled Kitchen Set**



**Wonderful 32-Piece Aluminum Set consists of 2 Bread Pans; Doughnut Cutter; 2 Loose Bottom Jelly Cake Pans; Combination Teakettle and Rice Boiler with lid; Saucepan Set with lid; Dipper; Colander; Measuring Cup; Percolator; 2 Pie Pans; Complete Castor Set; Tea or Coffee Strainer; Fry Pan; also cooker set of 5 pieces—makes 11 separate utensil combinations: Preserving Kettle; Convex Kettle; Combination Cooker; Casserole; Pudding Pan; Tubed Cake Pan; Colander; Roaster; Corn Popper; Steamer Set; Double Boiler.**

# No Money Down

Not a penny now. Just mail the coupon and Hartman will send you this splendid complete 32-piece Aluminum Cooking Set, and also the Free 10-piece Combination Kitchen Set. When the goods arrive make first payment of only $2.00 on the Aluminum Set. **Pay nothing for the Kitchen Set—it is FREE.** Use both sets *30 days on Free Trial*, and if not more than satisfied, send them back and we will refund your money and pay transportation both ways. If you keep them, pay for the Aluminum Set, a little every month. Keep the Kitchen Set as a gift from Hartman.

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## Complete 32-Pc. Aluminum Set and FREE Kitchen Set

This is Hartman's famous special, selected set of heavy gauge Aluminum Ware—a complete cooking outfit, light to handle, easy to clean, always bright as silver. Will never chip, crack or rust. So durable that we guarantee it for life. 32 utensils—everything you need for baking, boiling, roasting, frying. Just read the list above. You want and need everything there. Your kitchen is not complete without them. You really can't appreciate this splendid set until you see and use it. Then you will realize what a wonderful bargain it is. And without a penny's cost—**absolutely free**—you get a Combination Kitchen Set which gives you 10 utensils with white handles—all hung in a row—where you can reach them easily.

**Nearly a Year to Pay** Hartman gives the world's most liberal terms and the world's greatest values in dependable merchandise, and this offer proves it. You pay only $2.00 and postage on arrival (this on the Aluminum Set—not a penny to pay at any time on the Kitchen Set). Then, if after 30 days' trial you decide to keep it, pay a little every month. Take nearly a year to pay.

**FREE 10-PIECE KITCHEN SET**

Not a penny to pay for this set. You get it absolutely free with Aluminum Set.

| | |
|---|---|
| Potato Masher | Can Opener |
| Mixing Spoon | Vegetable and Pan Brush |
| Measuring Spoon | Fork |
| Ice Pick | Egg and Cake Turner |
| Egg and Cream Beater | Wall Rack |

All have white enameled handles and hang on wall rack, keeping them conveniently at hand.

**Order by No. 417EEMA7. Price for Aluminum Set, $18.95. No money down. $2.00 and postage on arrival. Balance $2.00 monthly. 10-Piece Kitchen Set is FREE.**

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**Dept. 5852** Copyright, 1923, by Hartman's, Chicago **CHICAGO**

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**Dept. 5852 Chicago, Ill.**

Send the **32-Piece Aluminum Cooking Set No. 417EEMA7, Price $18.95,** and 10-Piece Kitchen Set. Will pay $2 and postage on the Aluminum Set on arrival. Kitchen Set is FREE. I am to have 30 days' free trial. If not satisfied, I will ship both sets back. If I keep them, I will pay you $2 monthly until the price of the Aluminum Set, $18.95, is paid. Title remains with you until final payment is made.

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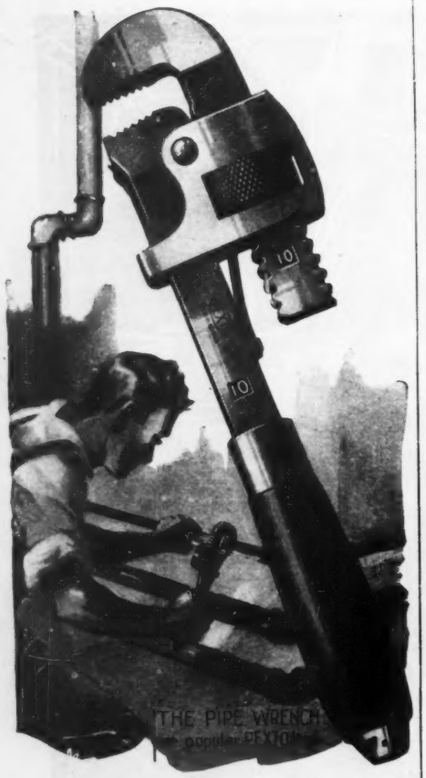


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PEXTO TOOLS are carried by practically all progressive dealers.

PEXTO

WORTH WHILE TOOLS

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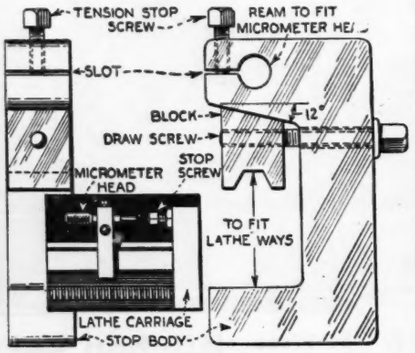
Southington, Conn., U.S.A.

## Micrometer Stop for Lathe

VERY often it is desirable to control the travel of the lathe carriage within closer ranges than can be accomplished with a non-adjustable stop fastened to the frame. By constructing such a stop body as shown so that it will hold a commercial micrometer head, and bringing the carriage to a stop against this, it will be found that the limits can be fixed much more accurately.

The micrometer head should fit snugly in the hole provided for it, but the tension stop screw should be adjusted so that it



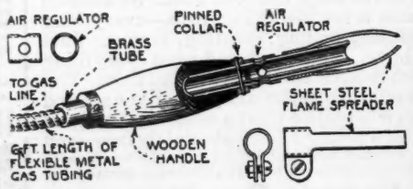

**A micrometer head clamped to the lathe bed serves as an accurate stop**

will not bind the thimble and prevent it from revolving freely.

The distance between the block and stop body, as well as the notch in the block, should be designed to fit the lathe ways. When the draw screw is turned to the right, the block is drawn down the 12-degree incline and clamps the stop in place. The micrometer screw can then be turned so that the proper travel limit will be established when the stop screw on the carriage bears against the head. Care must be taken not to bring the lathe carriage against the micrometer with too much force.

## Flexible Gas Heating Torch

FOR bench use the gas burning torch illustrated has several advantages. Because of the direct connection through a flexible metal tube with the gas line, the torch can be lit more quickly than a regular blowtorch. The flame is adjusted through the spreader and the intensity is controlled jointly through the gas




**For bench use this gas torch gives an easily regulated flame the moment it is lit**

petcock and the air inlet valve of the torch itself. The body is a brass tube fitted to a wooden handle with small thimbles. The air inlet is a sleeve fitting the center tube snugly, holes being drilled through both. The flame spreader is made of one piece of steel, as shown.

**For Pleasure or Profit**

Every man has a hobby from which he derives either pleasure or profit—or both. Through a better job, more quickly, more easily done, the man whose hobby is working in wood or soft metals can get more pleasure and more profit from work done on a

**Boice-Built Bench Machine**

The Pony Bench Machine shown here combines six machines in one: Saw, sander, drill, grinder, polisher and buffer. It saws 1½-inch stock with ease, and does mitering, dadoing, tenoning, etc. Easily driven by ¾-hp. or 1/3-hp. motor. Boice-Built machines are in use in thousands of shops, both industrial and private.

**An Excellent Gift for Man or Boy**

As a gift nothing could be more appreciated by the man or boy who likes to work with wood and soft metals. It will bring years of pleasure and profit to the recipient.

**Sold on a positive guarantee.** Every Boice-Built Machine is sold with a ten day trial money back guarantee.

The complete line of Boice-Built Bench Machines includes larger Bench Saws, Bench Band Saws, Bench Lathes, Bench Drills, Bench Jointers, and Motors. Write today for completely descriptive circular on any of these machines.

**W. B. & J. E. Boice, Dept. P. S. 12, Toledo, Ohio**

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STAYPREST Trouser Presser puts a real master-tailor crease in pants. Takes the bag out of knees and removes wrinkles. Easy to use—takes only a few seconds. Always a like-new press without delay or trouble. A real convenience. Saves many dollars in pressing bills, and trousers always look like just from the tailor. Makes them last longer. Saves nap of cloth which ironing ruins. Every man should have at least one or two.

Stay Prest

Made of selected hardwood, fabric covered, canvas lined. All metal parts heavily nickel plated. Fits any size trousers. Folds into small pack to fit handbag. Strong but light. Has collapsible coat hanger. Lasts a lifetime. Thousands in use. Well dressed men have several to keep all trousers well pressed. Sold through dealers, agents or direct by mail. Mailed postpaid on receipt of $2.50. C.O.D. if desired. Satisfaction or money back. Order today.

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The Getgey-Jung Co.
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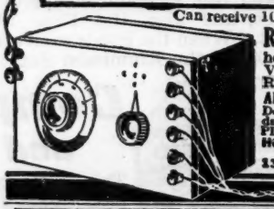

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RUSH your name to learn how you can get a Vacuum Tube Radio Set ABSOLUTELY FREE Don't delay; write today for FREE RADIO PLAN.

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Time, Labor, Belts, Power, Money and Annoyance by Using

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WIRE HOOK, STAGGERED GRIP

BELT LACING

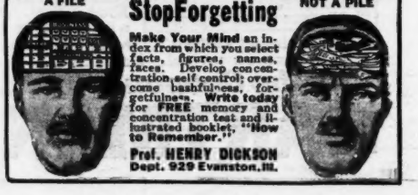
Complete outfit including lacing tool, post paid $5. Laces belts for 1¢ an inch.

Detroit Belt Lacer Co.
Detroit, Michigan

A FILE

**StopForgetting**

NOT A PILE



Make Your Mind an index from which you select facts, figures, names, faces. Develop concentration, self control; overcome bashfulness, forgetfulness. Write today for FREE memory and concentration test and illustrated booklet, "How to Remember."

Prof. HENRY DICKSON
Dept. 929 Evanston, Ill.

# The "A" Battery's Power in Your Radio Receiving Set

THIS IS NUMBER TWO OF A SERIES

THE sole purpose of the "A" Battery in your Radio Receiving Set is to furnish current to heat the filaments of the tubes.

And this can be done satisfactorily only by an "A" Battery that supplies an adequate steady current.

Anticipating the popularity of the dry cell tube in Radio, and realizing that it required a Dry Cell capable of standing up under service conditions differing from what dry cells are called upon to meet in other fields, the National Carbon Company developed the Eveready Radio Dry Cell specifically for this new use.

A dry cell gives its maximum service only when designed especially for the work it is intended to perform. There are for dry cells several uses which are so alike that one type of cell serves for all. This is the field covered by the ignition or general purpose dry cell.

The conditions encountered in Radio are different from the conditions grouped together under the term "general purpose." And while the general purpose dry cell performs well as an "A" Battery, it was found possible to produce a Dry Cell "A" Battery capable of delivering more service on Radio loads.

Thirty years of dry cell experience and an immense research organization resulted in the superior Eveready Radio Dry Cell. One of the outstanding features of this special cell is that while it will last much longer when used as an "A" Battery, it is no larger than the standard dry cell.

The increased service life of the Eveready Dry Cell "A" Battery greatly offsets the slight increase in cost; so this battery is not only the best, but it is the most economical you can buy. "The Story of Eveready Dry Cell Radio 'A' Batteries," which tells how to use Dry Cells to the greatest advantage with the various dry cell tubes now available, will be sent to you free on request.

* * * *

The "A" Battery gives power to your Radio Receiving Set. Eveready Batteries—especially made for Radio—serve better, last longer, give better results.

*Note: This is number 2 of a series of informative advertisements which will appear in this magazine. They are designed to help users get the most out of their Batteries and their Radio Sets. If you have any battery problem, write to G. C. Furness, Manager Radio Division, National Carbon Company, Inc., 116 Thompson Ave., Long Island City, N. Y.*

## POWER

### for Your Radio Set

**Eveready Dry Cell Radio "A" Battery (No. 7111)**

Directions and wiring diagrams on the jacket tell just how to use this battery with the different dry cell tubes.

This special Radio Cell is also available in two and four cell multiple batteries for receiving sets employing from two to four WD-11 or WD-12 tubes.

**Other Radio Batteries**

**Eveready Storage "A" Batteries**—best suited for filament heating of all Radio Tubes not especially designed for dry cells. The quality storage battery with the long life plates, $15 to $20.

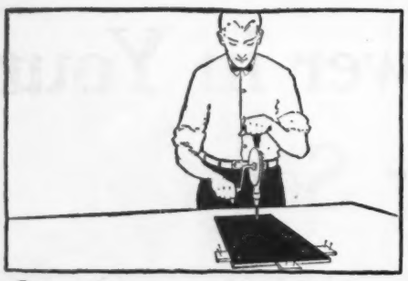
**Eveready "B" Batteries**—the life of your Radio.

**Eveready "Three" Battery**—3 cells, 3 purposes.

*Manufactured and guaranteed by*

**NATIONAL CARBON COMPANY, Inc.**

# EVEREADY
## Radio Batteries
*—they last longer*



*The Supreme Insulation*

**RADION Panels are easiest to drill, saw or engrave with simple tools at home**

**18 Stock Size Panels**

Furnished in 18 stock sizes.

| | |
|---|---|
| 6 x 7 | 7 x 21 |
| 6 x 10½ | 7 x 24 |
| 6 x 14 | 7 x 48 |
| 6 x 21 | 9 x 14 |
| 7 x 9 | 10 x 12 |
| 7 x 10 | 12 x 14 |
| 7 x 12 | 12 x 21 |
| 7 x 14 | 14 x 18 |
| 7 x 18 | 20 x 24 |

Radion, being an insulation material especially made for wireless use, has the lowest phase angle difference, lowest dielectric constant, highest resistivity and supreme moisture, gas and acid repelling properties.

Send 15c for sample test piece of RADION panel 2x3 in. Try it with your own drill.

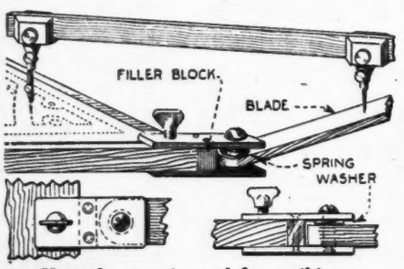
**American Hard Rubber Co.**
11 Mercer St., New York

**RADION**
*Panels-Dials-Knobs-Sockets-Insulators*

## Extension Arm Aids Draftsman in Drawing Large Work

ALL draftsmen who have used small drawingboards know how difficult it is to scribe radii, the centers of which are beyond the edges of the board. In such cases a detachable extension arm is a great aid.

The device illustrated consists of a clamping fixture and a soft wooden arm. Two pieces of steel with a spacer between are riveted together and a thumbscrew



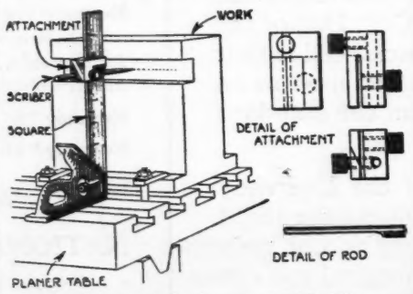

How the arm is used for scribing a large arc, and details of the clamp

is used to clamp the fixture to the drawingboard wherever needed. The arm itself is pivoted between the steel pieces by means of a screw and spring washer. The tension should be adjusted so that the arm will remain quite firmly wherever placed.—C. M. WILCOX.

## Direct-Setting Scriber Extends Range of Machinist's Square

BY MEANS of the simple attachment shown, an ordinary square is converted into a direct-setting scriber that will be found useful when scratching a center line on work that is strapped on a planer table and in many other places where the work is not easily accessible.

The drawing explains itself, but it should be noted that the beveled, cutaway setting edge is in the same plane as the scriber retaining hole. Thus, when the setting edge is brought to its predetermined position and clamped by the thumbscrews, the scriber point will be the same




Reading on scale shows actual height of scriber point above table

distance from the bottom of the square as the reading on the scale indicates.

By substituting a rod milled as shown in the detail in place of a scriber point, the device can be used as a direct-reading surface gage, wherever circumstances permit. In difficult locations, when the special rod cannot be used, the difficulties may be overcome through the agency of a common curved point, the contrivance then being used as surface gage.


**Radio Bargains for THIS MONTH**

| | |
|---|---|
| Hedgehog Transformer | $3.15 |
| Reflex Crystal | .89 |
| Battery Test Clips (each) | 05 |
| 199 Tube Adapter | .49 |
| Licensed Neutrodyne Parts | 19.98 |
| Rheostats, 6, 25, 40 ohm | .69 |
| Variocoupler or Variometer (180 degree) each | 1.28 |
| Erla Reflex Transformer | 4.65 |
| Murdock 2000 Ohm Phones | 3.65 |
| Jewell Lightning Arrester | 98 |
| Cico Two-way Plug | .49 |
| Cockaday Coil, each | 1.89 |
| Contact Points or Switch Stops, per dozen | .10 |
| Special Prices on Tubes, Magnet Wire, etc. | |

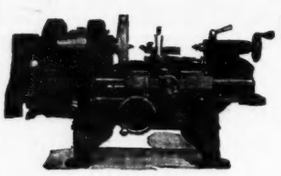
Clip this List—Check Items You Want. Enclose with Money Order

*Your Order will be Filled by Return Mail Postage Free—Satisfaction or money back*

FANS LIST OF BARGAINS FREE

**RADIO BARGAINS**
17 N. LA SALLE ST-CHICAGO

**"The Biggest Little Lathe Built"**



**THE MONARCH Junior Engine Lathe**
9-inch Engine Lathe 2½ ft. bed
**$245**

Here is a sturdy, small engine lathe built with the same quality construction that has made MONARCH Lathes standard the world over. Guaranteed to do any small work any other lathe will do and do it with 1/1000 of an inch accuracy. It will fit in any shop or home work room. Easy to learn to operate.

*Write for Free Catalogue of MONARCH Lathes which are built up to 30-inch swing.*

**THE MONARCH MACHINE TOOL CO.**
401 Oak Street Sidney, Ohio

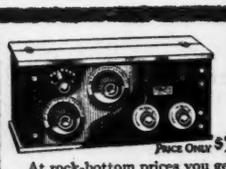
**How To Make Things Electrical**

**Have the fun of doing it yourself and save half the cost**

This book gives directions for making hundreds of electrical appliances and devices for the home, the shop and the garage. The simple directions and many drawings make the work easy.

*429 pp. Price, $1.50 postpaid*

**POPULAR SCIENCE MONTHLY**
225 West 39th Street, New York City



**MIRACO GETS 'EM FROM COAST to COAST**

PRICE ONLY $29.50

At rock-bottom prices you get the efficiency of sets costing three times as much. Users tell us that Miraco Radio frequency receivers pick up stations from coast to coast. Operate either on dry cells or storage battery. Solid mahogany cabinets—finest workmanship throughout. Order direct or send for bulletin.

| | |
|---|---|
| One tube outfit | $18.50 |
| Two tube outfit | $29.50 |
| Four tube outfit | $54.50 |

DEALERS AGENTS —Write for proposition quickly—it's a winner.

**THE MIDWEST RADIO COMPANY**
808 Main Street Cincinnati, Ohio

# Radio Catalogue Free—

**Write us a post card—**
**Address Dept. 5-R**

and we will send you free this 52 page catalogue of radio sets and parts. It also contains explanation of radio terms, map and list of broadcasting stations and much radio information, including an explanation of successful hook-ups and circuits.

You will be amazed at the low prices Ward's quote. A complete tube set having a range of 500 miles and more, including tubes, head set, batteries, and antenna equipment, as low as $23.50.

This catalogue contains everything for the expert and amateur. Complete sets and every improved part for building sets, all the most up-to-date devices—at the lowest possible prices.

## Headquarters for Radio

Montgomery Ward & Co. is headquarters for Radio, selling everything direct by mail without the usual "Radio-profits." Why pay higher prices? Ward quality is the best and the prices will often save you one-third. Everything sold under our Fifty Year Old Guarantee,—Your Money Back if You Are Not Satisfied. Write today for your copy of this complete 52-page Radio Book.

**Write to our house nearest you. Address Dept. 5-R**
**Chicago Kansas City St. Paul Portland, Ore. Ft. Worth**

# Montgomery Ward & Co.

**The Oldest Mail Order House is Today the Most Progressive**

# *Inspect it— point by point*

**1** In our previous advertisements we explained three points of Superiority of Brown & Sharpe Micrometers. The first of these is the Precision Measuring Screw made on our special machines.

**2** The second point of superiority is the Clean Cut Graduations. The first graduating machine in America was a Brown & Sharpe.

**3** The third point of superiority is the accurate Fit of the Spindle and Anvil testified by the many Brown & Sharpe Micrometers in use 30 or 40 years and giving faithful, accurate service today. Now we invite your inspection of the complete superiority of Brown & Sharpe Micrometers, point by point.

## BROWN & SHARPE MICROMETER CALIPER No. 8

**Brown & Sharpe Micrometers** are made in the largest factory of its kind in the world, from the finest material, by skilled workmen. The highly accurate Micrometer Screw is made on our own special machines.

**Improved Design** is worked out from actual requirements in our large plant.

**The Spindle fits** the hub.

**The Clamp Ring** is a Brown & Sharpe Invention.

**The Adjustments** for wear are the best yet devised—although wear after many years of use is scarcely perceptible.

**The Finish** of the micrometer is distinguishing and in keeping with the superiority of the Tool.

**The Standards** we use are our own—and obtained from the Government Bureau of Standards.

**Inspection** is exacting—here experience is again a factor—we made the first micrometer in America.

**The Brown & Sharpe Measuring Machine** is our own product and measures to one-one hundred thousandth of an inch.

The Brown & Sharpe Micrometer measures accurately and wears long. Don't ask for a micrometer—demand Brown & Sharpe.

Our Small Tool Catalog describes the complete line of Brown & Sharpe Tools. You may want a copy of "The Micrometer" also—a little text book of valuable information.

*Write for them today.*

BROWN & SHARPE MFG. CO. Providence, R. I., U. S. A.



**COLD PIPE BENDERS**

*Standard of the World.*

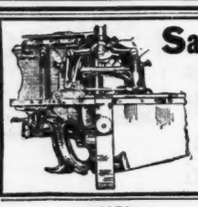
**HAND and MOTOR OPERATED**

14 Sizes of Machines
What it costs to bend pipe our way. Per bend.
1" pipe 5 cents 4" pipe 25 cents
2" pipe 10 cents 6" pipe 60 cents
8" pipe $1.00
Send for Catalogue.

AMERICAN PIPE BENDING MACHINE CO.
51 Pearl St. Boston, Mass.



**Saw Filing Pays**



Buy a Foley Saw Filer and Setter and establish an independent, profitable business. Write today for FREE Catalog. *Territory open to interested parties.*

FOLEY SAW-TOOL CO.
3613 Portland Avenue
MINNEAPOLIS, MINN.



**WORKRITE NEUTROFORMER**

*(Licensed under Hazeltine Patent No. 1450080)*

THIS instrument is made up of one WorkRite Variable Condenser and one WorkRite Neutrodyne Transformer mounted together. It is correct in every detail. WorkRite Neutrodyne parts will make your set efficient and reliable. Use all WorkRite Parts.

WorkRite Neutroformer.....$5.50
WorkRite Neutrodyne Transformer.....2.00
WorkRite Neutrodon.....50

**WORKRITE NEUTRODYNE KIT**

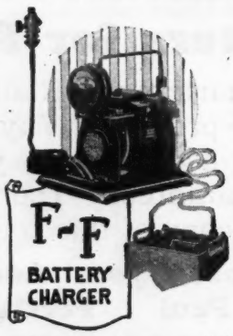
3 WORKRITE NEUTROFORMERS
2 WORKRITE NEUTRODONS
**$17.50**

Panel chart and complete instructions

ORDER YOUR KIT TODAY!
THE WORKRITE MANUFACTURING CO.
1810 E. 30th St., Cleveland, Ohio
Branch Office, 536 Lake Shore Drive, Chicago)



**The Ideal Gift For Your Radio Friend**




**$15.00**
F. O. B. Cleveland

Type 6 charges 6 Volt Storage Battery from any 110 Volt 60 Cycle lamp socket at average rate of 6 amperes, or over if battery needs it.

Scarcely a gift you could think of will bring more genuine appreciation than the satisfaction obtained from an F-F Battery Charger.

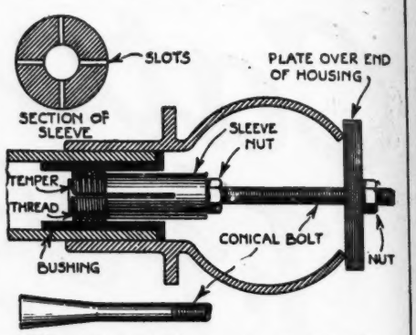
Buy from your dealer. If he cannot supply you, write for literature or enclose remittance covering express or postal charges on 9 lbs.

**IT'S FREE—Write for Bulletin No. 17.**

**The France Mfg. Co.**
10417 Berea Road Cleveland, Ohio
Pioneer Manufacturers of Patented Battery Chargers


## Extractor Pulls Stubborn Roller Bearing Sleeves and Bushings

BUSHINGS and bearing sleeves can easily be removed from their housings by means of the extractor shown. A hollow threaded sleeve is cut longitudinally for three quarters of its length with two slots at right angles to each other. The sleeve is then fitted with a bolt, one end of which is upset to form a cone.

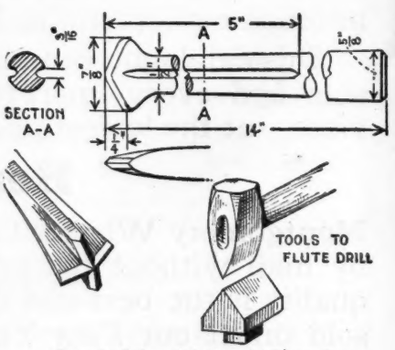



**When the outside nut is turned, the threaded sleeve expands and pulls out the bushing**

After the sleeve is slipped into the bushing, the expanding screw is drawn tight by turning up the nut, which bears against a plate over the end of the housing. As the pressure is increased, the threads of the sleeve firmly grip the bushing, which is pulled from its seat.

## Fluted *versus* Star Drill

THE star drill is generally used by electricians, plumbers, steamfitters, and other mechanics to drill holes in concrete, brick, and stone. When it becomes dull it must be sharpened by a blacksmith who has the necessary dies and dollies. When used by hand, it also has the objection, to my mind, of requiring more force than necessary, because the center cutting edges tend to retard the cutting.




**A typical fluted drill, which can be sharpened easier than a star drill**

A tool easily made in the ordinary blacksmith shop, that will drill rapidly and, I believe, with less effort, is the fluted drill illustrated in detail. The flute, which allows the dust to clear itself during drilling, can be made without difficulty by using ordinary splitting tools. The point of the bit is shaped the regular chisel pattern.—J. C. LAMON, Alcoa, Tenn.

## *MAGNAVOX Products*

EVERY condition in the art of radio reproduction is most successfully met by Magnavox apparatus.

### *Reproducers*

R2 with 18 inch horn **$60.00**

R3 with 14 inch horn **$35.00**

M1 with 14 inch horn; for dry battery sets . **$35.00**

### *Combination Sets*

A1-R consists of Magnavox Reproducer with 14 inch horn and 1-stage Amplifier . . . . **$59.00**

A2-R same with 2-stage Amplifier . . . **$85.00**

### *Power Amplifiers*

A1-One-stage . . **$27.50**

AC-2-C-Two-stage **55.00**

AC-3-C-Three-stage **75.00**

Radio users will be sent new 32-page Magnavox Radio Catalogue on request.

## *Magnavox brings you the Voice of All Christmastide*

THE Art of Radio Reproduction is enjoyed by every Magnavox owner. Despite the ever-increasing quality and variety of Broadcast Programs, many a receiving set gathers dust unlamented because of insufficient sensitivity or an unsatisfactory "loudspeaker."

Every Magnavox owner is a master of the art of radio reproduction—the results obtained by the use of Magnavox Reproducers and Power Amplifiers cannot be equalled with apparatus constructed in the ordinary way.

The special attention of dry battery receiving set owners is called to the new Magnavox Reproducer M1, illustrated above.

Magnavox Products can be had of good dealers everywhere.

THE MAGNAVOX COMPANY
Oakland, Calif.
*New York Office*—370 Seventh Avenue
Perkins Electric Limited—*Canadian Distributors*
Toronto, Montreal, Winnipeg

# MAGNAVOX PRODUCTS

*There is a Magnavox for every receiving set*

12R

*"Red Devil" Rapid Boring Auger Bits are 33 1/3% easier boring, have 10% greater clearance, and bore with or against the grain of any wood. Style 2400—10/16 in. shown here, 75c.*

# Red Devil PLIERS

## *100 Styles—One for Every Need*

A PAIR of "Red Devil" Pliers multiplies by many times the number of useful things you can do about the house, shop, factory, garage. Hanging pictures, turning nuts and bolts, mending vacuum cleaners or sewing machines, amateur plumbing, etc.

Forged of steel, and distinctly superior in design. Just a few of the 100 styles shown here.

### Slip Joint Plier No. 1024

(Shown at top.) For all around use. The thin nose gets into tight corners. Slip joint gives wide range to gripping jaw. Wire cutter and screw driver add to the number of things you can do with it. Sizes 5½ and 6½ inches. 6½ inch size, $1.00 a pair.

### Side Cutting Plier No. 50

About as useful a tool as any mechanic can own. Powerful cutting edges. The standard electrician's plier the world over. Sizes 4, 5, 6, 7, 8 inches; 6-inch size, $1.10 a pair.

### Combination Plier No. 999

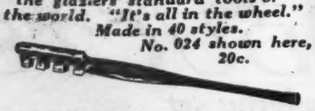
For handling nuts, pipes, wire. Heavy enough for use as a hammer. Ideal for heavy work in general. Sizes 6½ and 8½ inches, 6½-inch size, $1.00 a pair.

"Red Devil" pliers are on sale at all dealers—ask to see the complete line.

*The "Red Devil" Mechanics' tool booklet is a handy reference guide for users of good tools. Send for it, it's free.*

**SMITH & HEMENWAY CO., Inc.**
*Manufacturers of "Red Devil" Tools*
264 Broadway, New York, N. Y.

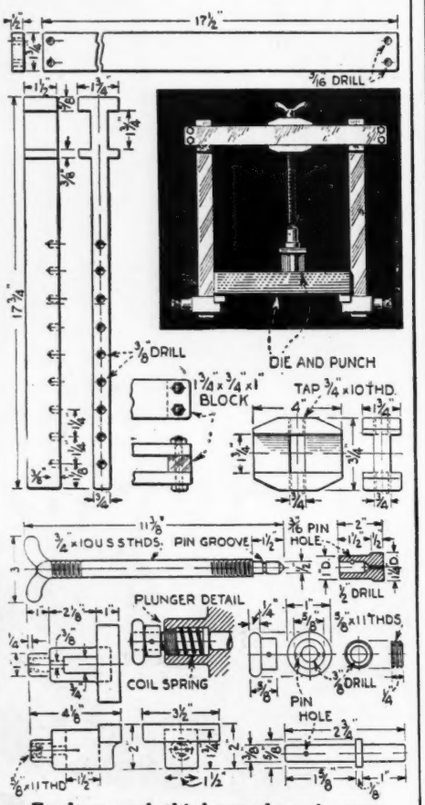
*"Red Devil" Glass Cutters—the glaziers' standard tools of the world. "It's all in the wheel." Made in 40 styles. No. 024 shown here, 20c.*




## How to Make an Improved Die Clamp

THIS die clamp, which will hold 12 by 12 in. pieces, is an improvement on the old "crab" clamp still widely in use.

With the crab clamp, the legs diverge whenever large pieces are inserted, and the leverage becomes correspondingly weak. With the clamp shown, the legs remain parallel, the base of the die rests firmly upon the legs, and a powerful direct pressure can be brought to bear




**For large work this heavy clamp is superior to the ordinary "crab" clamp**

upon the upper surface at any point across it.

The legs are loosely suspended from the cross piece so that the clamp can be adjusted for dies of any width up to the maximum.

If made half the size shown, the clamp would be a valuable addition to any machinist's toolkit for general work.

### Expert Mechanics Tell How They Save Labor

"I'VE got some excellent shop ideas from your magazine," is a statement that appears in one form or another in many letters from our readers. That is because the best mechanics in the country write for POPULAR SCIENCE MONTHLY. If you are a mechanic, it will pay you to read the Better Shop Methods Department regularly. The January issue has articles by Laraby, Romig, Luers, Wheeler, Wilcox, Wicks and others, whose names are sufficient to guarantee the value of the material.


# Morrison

*Loud Speaker*

## Radio Satisfaction

True enjoyment of Radio begins when you and your family can sit comfortably in your living room and listen to all broadcasting reproduced in Clear, Full Volume. No annoying rattles, no harsh vibrations, no need for constant adjusting and fussing.

Morrison Loud Speaker gives you that kind of Radio satisfaction and pleasure, when attached to either your

## Phonograph or Horn

Attach the Morrison Loud Speaker to the tone arm of your phonograph—takes only a moment—and you have the benefit of the excellent phonograph sound box. Or attach it to any horn.

A little dial on the back of the Morrison Loud Speaker adjusts the tone from soft, mellow notes to full-volumed, clear notes.

There is nothing to get out of order. Any one can use this wonderful radio unit with the same perfect results as an expert.

*Satisfaction guaranteed—or your money back.*

**Price complete with 5 foot cord**

**Nickel Plated Model ..... $10.00**

**Gold Plated Model ..... $15.00**

Order from your dealer, or send direct to us if your dealer cannot supply you.

### DEALERS

If you are interested in one of the fastest-selling Radio units on the market, write or wire for our proposition—it is interesting.

*Write for Illustrated Catalog.*

**MORRISON LABORATORIES, Inc.**
**341 Jefferson Ave., East Detroit, Mich.**

# The Wireless Experimenter's Manual

**E. E. Bucher**

THIS book thoroughly covers the entire field of amateur radio work, including the theory and design of amateur wireless transmitters and receivers, the construction of transformers, high voltage condensers, spark gaps, aerials, masts, and receiving sets for long and short wave receptions. 330 pp. Fully illustrated. Price $2.25.

# Practical Amateur Wireless Stations

This book contains best suggestions of thirty-three experimenters on building, installing and operating experimental stations for radio communication.

*Profusely illustrated. 137 pp.*

**PRICE 75c**

**POPULAR SCIENCE MONTHLY**
**225 West 39th St. New York City, N. Y.**

# Hello Boys! ERECTOR

## BUILDS LOTS OF TOYS

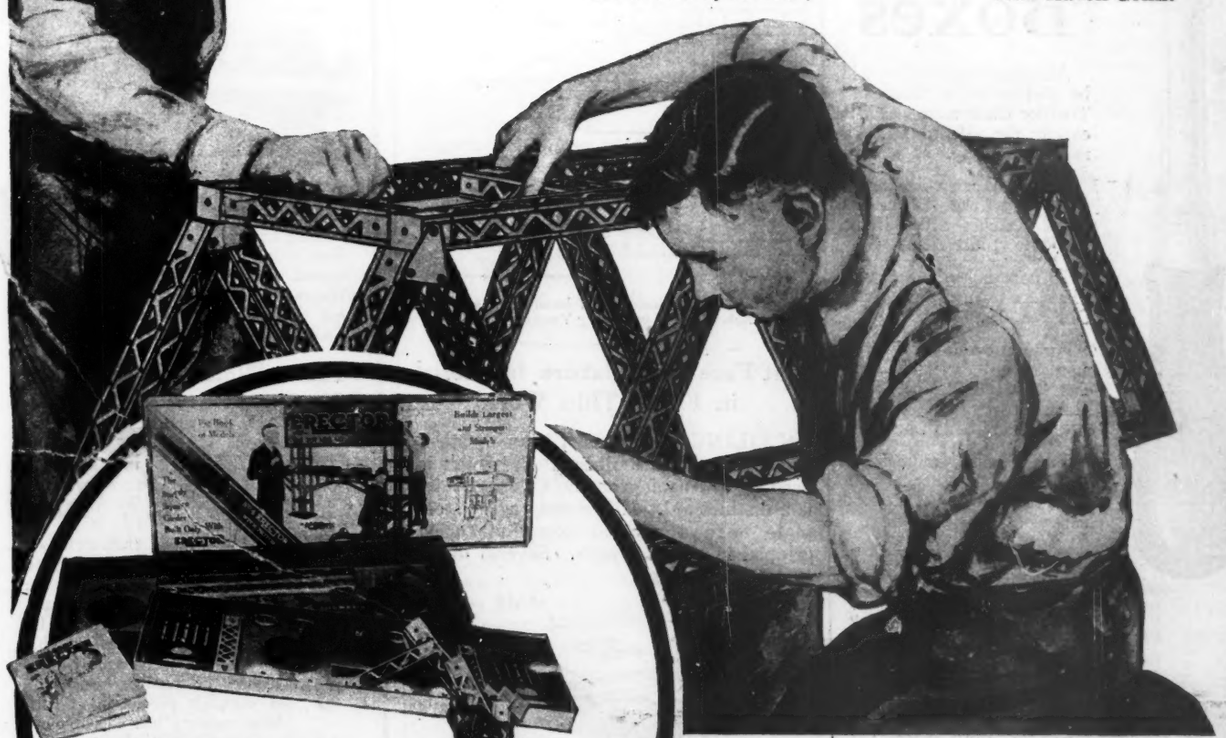
*Gilbert Erector is the only steel Construction Toy that builds square Girders*

BOYS make wonderful models of bridges, cranes, derricks, wind-mills, skyscrapers, railroad signals, Ferris Wheels and machinery. Erector is not only the best fun in the world but it is splendid training.

***This famous Construction Toy will delight any boy this Christmas***

ERECTOR is the only actual structural steel toy. Every part is scientifically proportioned and correct in design. The boy who owns Erector or any other Gilbert Toy is made a member of Gilbert Engineering Institute for Boys, without cost. He can win valuable prizes, degrees and diplomas in this great Fraternity of American Boys.

THE A. C. GILBERT COMPANY
222 Blatchley Avenue, New Haven Conn.



**$5** *Gilbert Erector No. 4*

THE most popular set. In addition to hundreds of parts it contains a sturdy Electric motor to operate cranes, draw bridges and machinery models.

THE A. C. GILBERT CO.
222 Blatchley Avenue, New Haven, Conn.

Send 10c to-day for Gilbert Year Book for 1924. Chock full of interesting articles for boys, chemical experiments, athletic sports, tricks, useful items any boy can make, story of great engineering feats, etc., as well as a complete catalogue of the many Gilbert Toys. Enclosed find 10c. Send me Gilbert Year Book for 1924.

*Name* .....

*Address* .....

*City* ..... *State*.....

# In Gift Boxes

Almost any man or boy will be glad to get a "YANKEE" Tool for Christmas; and it is exactly the gift to make a mechanic happy.

For quick screw-driving, a man needs the "YANKEE" Spiral Ratchet Screw-driver **No. 30.** (Illustrated.)

To bore holes he wants a "YANKEE" Automatic Push Drill **No. 41.**

For work on his car give the motorist a "YANKEE" Ratchet Breast Drill **No. 1555.** Makes easy work of jobs that other drilling tools won't do.

Does he build radio sets? "YANKEE" Ratchet Hand Drill **No. 1530** is just the tool he needs.

Anybody who works at a bench will value a "YANKEE" Vise **No. 1992.** Swivel base.

Then there is the "YANKEE" Tool Set **No. 100**—a full set of screw-driving tools, with attachments for drilling, etc. Solid oak case.

See the "YANKEE" Tools in Christmas Boxes, at your hardware dealer's. He will help you in your selection.

*"Yankee" Tool Book sent free on request.*

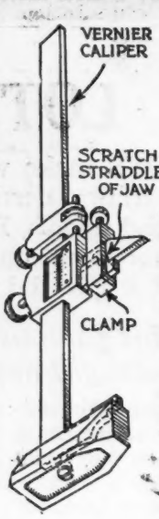
NORTH BROS. MFG. CO., Philadelphia, U. S. A.

"YANKEE" TOOLS

*Make Better Mechanics*

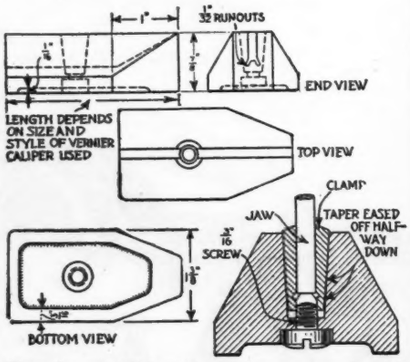

## Making a Height Gage Base for a Vernier Caliper

A SUBSTITUTE for a Vernier height gage, which is one of the more expensive small tools in the shop, can be made from a Vernier caliper. All that is necessary is a firm base and a scratch blade.




The base is tool steel, hardened and ground. Its length should be proportioned to the size of the caliper jaws to insure stability. The base is fixed to the stationary jaw of the caliper with a tapering clamp, as shown. The screw that draws down the clamp must be located exactly in the center of the base.

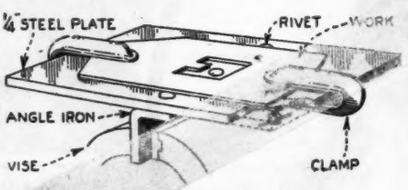
The scratch is clamped to the movable jaw with the point projecting well beyond the end of the base.




**How the scratch point and base are made and attached to an ordinary Vernier caliper**

## Flat Face Vise Fixture Is Useful in Filing Thin Work

IN FILING thin parts of brass or steel, the vise fixture illustrated, which is used by a Washington, D. C., mechanic, is a distinct aid. It is simply a flat steel plate, with a vertical extension to be gripped in the vise jaws. Several deep-throated C clamps are used for fastening the work to the face of the rest. The work is turned about as required to finish any part of the face either by shifting the clamps or turning the vise about, if the base is of the swivel type. A size for the flat plate for average use is 6 by 10 in.




**The work is fastened with C clamps to a table held in the vise**


# Pieces-per-Hour Tell You Straight

Are you getting *ahead* with the practical development of your machine?

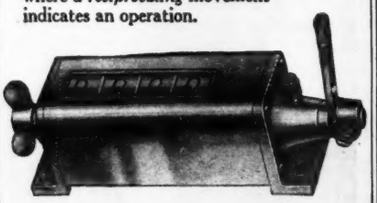
Are you getting larger *production* with each change in design or working adjustment?

Is the operator of the machine getting *his* methods down fine?

Your answer lies in the number of *pieces per hour*—recorded always reliably by a

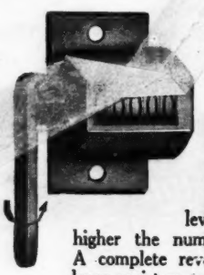
Veeder COUNTER

The Set-Back Rotary Ratchet Counter below is for machines such as presses and metal-stamping machines, where a *reciprocating* movement indicates an operation.



Registers one for each throw of the lever and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50—subject to discount. (*Cut less than ½ size.*) Set-back *Revolution* Counter of similar model, $10.00 (list).

This *small* Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of innumerable small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter, also $2.00.



***Everything you could ask in a counting device is shown in the 80-page Veeder booklet. Ask for this fine free book.***

**The Veeder Mfg. Co.,**
**44 Sargeant St., Hartford, Conn.**

# How three boys built a railroad

THREE boys sat disconsolately on the edge of the pond back of the old mill on the Jenkins' place. All week they had been building a railroad in the sand along the banks. They had leveled, and dug, and built up until they had the bed laid for a whole transportation system. There were grade crossings, and bridges and freight yards and even a tunnel. While along the edge of the pond Wally had built docks and ferry boat slips. But as Bob said, "What good is a railroad without any cars?"

"Why all the gloom, men?" said a pleasant voice behind them. The three boys looked up to see Mr. Jenkins, Bill's father.

Bill explained the lack of "rolling stock" for their railroad.

"Well!" said Mr. Jenkins, "Why don't you fellows chip in and get track and trains? In New York, I've seen some beauties that operated by electricity. They were exact duplicates of the big ones that run on the Central."

"Chip in?" asked Wally, showing empty pockets, "Chip in what?"

"My golly!" said Mr. Jenkins. "Anybody'd think you fellows were cripples. When I was a boy, if I wanted anything bad enough, I just went out and earned the money and got it. I know Bob there could make some money if he'd saw that big pile of wood I saw yesterday out in the back of his Dad's place. Wally can pick the apples down in the orchard and I'll find something for Bill to do. Get busy and see what you can earn. And then I'll tell you what I'll do! I'll give you a dollar for every dollar you earn. How's that, fair enough?"

"Oh boy!" Bob cried.

"Let's see that orchard," said Wally.

"Let's go!" shouted Bill, getting up in a hurry.

### *First meeting of the R. W. & W.*

A MONTH later, the first meeting of the R. W. & W. Railroad (R—Robert, W—William, W—Walter) was held. Mr. Jenkins collected the money the boys had earned for the railroad.

Wally had seven dollars, Bill eight and Bob ten.

"That makes twenty-five dollars," announced Mr. Jenkins. "And now, as I said I would, I'll match your capital with the same amount." He took two new ten dollar bills and a five from his pocket and put them with the boys' money. "Total capital of the Railroad—fifty dollars."

"And now, gentlemen, if you three will meet me tomorrow morning early, we'll all go into New York on the eight o'clock and purchase 'rolling stock' for the railroad."

### *They buy "rolling stock"*

WHAT A day those four had in the city!

Mr. Jenkins took the three boys down to the Ives Display Room in the Fifth Avenue Building at Madison Square.

On great tables, which ran all around the big display room, were complete railroad systems. Powerful electric engines, perfect models of their big brothers on the Central, thundered along with mail coaches and Pullmans. A freight engine rumbled by, pulling a long line of flat cars, tank cars, and cattle cars, and in the rear a caboose. The boys looked on wide-eyed and noticed that each car was a perfect model of the real thing, even down to the monograms on the cars, which showed the cross of the Santa Fe, the seal of the N. Y. C. & H. R., the red and white circle of the Canadian Pacific.

There were semaphore signals, which showed red and green lights. Crossing signals that rang a warning bell as the Flyer approached. Trestle bridges, tunnels, freight and passenger stations, telegraph poles and street lights. In fact everything that you have ever seen in a big railroad.

There was a shriek from Wally.

"Oh boy! Look at these." He had found a big table on which were ocean liners, freight steamers, submarines, tug boats and racing yachts. "Gee! Couldn't we have some ships, too?"

"How about it, boys," suggested Mr. Jenkins, "couldn't we make Wally Captain of the Port and let him handle the ocean transportation?"

Everyone agreed to this and Wally, with the professional eye of a sea captain, picked out a liner, a tug boat for hauling freight, and a diving submarine for harbor defense.

### *The grand opening*

A WEEK later, down behind the old mill, there was a scene of tense excitement. Lined up on the bank were Mr and Mrs. Jenkins, Molly—Bill's little sister. Ambrose—the colored man who cut their lawns, and Rags, the dog. Bob knelt on the ground beside a switch. Wally fussed with the mooring ropes of a liner which rode proudly beside her pier. Bill fastened an American flag to the halyards on a pole. All along the bank, ran the new railroad's tracks, gleaming in the sun. The semaphore signals showed "Clear track ahead."

"Ready!" cried Bob.

"Ready!" answered Wally and Bill.

Rags barked. Mr. Jenkins waved his hat and Mrs. Jenkins her parasol. Ambrose clapped. Molly shrieked.

Then Bob turned the switch and out of the door of the old mill rolled the Flyer, headlight gleaming, parlor cars lighted. Along the bank it flew, round curves, through tunnels, over bridges. Then came a long freight loaded with lumber and gravel for "overseas." Down to the water front it went and there stopped alongside a pier.

"How about the R. W. & W?" shouted Bob.

"Yea!" hollered Bill and Wally and Mr. Jenkins and Ambrose.

Suddenly little Molly began to cry as though her heart would break.

"Why, dear, what's the matter?" asked Mrs. Jenkins.

"I wish I was a boy," sobbed Molly.

And after all you couldn't blame her much—could you?

*On November 30th, at 8:30 P. M., Mr. H. C. Ives will give radio talk. "The Fun of Playing with Trains," Station W. E. A. F., wave length, 492 meters.*

THE IVES MANUFACTURING CORP.
285 Holland Ave. Bridgeport, Conn.

I enclose 10c for which please send me your new smashing 28-page book that shows how to build an Ives Railroad. This book will also tell me about the Ives Fleet of boats.

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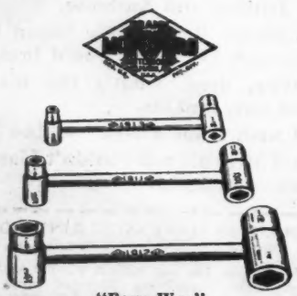
Chrome Manganese Steel

Wrenches and Tools

DON'T send a boy to do a man's work—or an inferior wrench to tackle a nut or bolt that's hard to handle. Make sure that the wrench or tool you select for that difficult job is a Mossberg.

Each Mossberg Wrench is designed and built for a particular job—and the Mossberg idea is to have that wrench do the job a little better than any other. Hence the use of chrome manganese steel throughout the entire line—the one piece, solid construction of the majority of Mossberg Wrenches—the exclusive designs.

Ask your dealer to show you Set No. 1900—three socket wrenches with twelve openings. Note the rugged construction of these wrenches—they are typical of the Mossberg line, in economy, strength and simplicity.



"Four-Way" Socket Set

FRANK MOSSBERG CO.

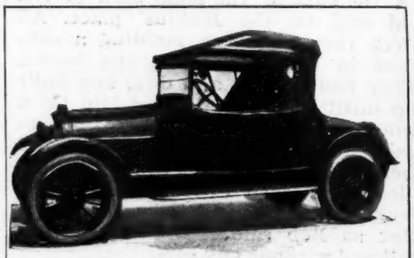
Lamb Street, Attleboro, Mass.

*The Home Workshop, Continued*

# How to Rebuild a Broken-Down Car

By Ray F. Kuns

*Principal, Automobile Trade School*
*Cincinnati, Ohio*



**Ready for the Road**

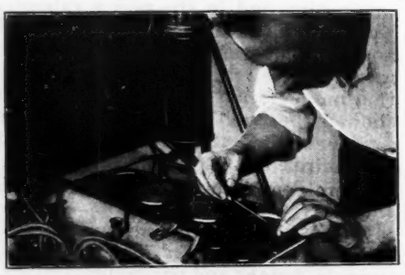
This is the last of three articles telling how Mr. Kuns rebuilt the 1918 roadster six shown above. It cost $75 and the materials for repairing it, including paint, top, and tires, totaled $135

THE frame of the old car again is suspended from the springs. The wheels are again on the axles. The transmission system is installed again on its bearings, and the engine, separated into its component parts, is lying on the bench.

Before reassembling the motor, look carefully at each part. Allow no worn bearings, bent valve stems or other defective elements to escape your attention.

First of all, get a new set of gaskets to replace the old ones. Look at the oil lines and the oil pump to see that there are no obstructions. Then replace the valves, taking care that they are put into the block in the same order in which they were removed previous to grinding. The intake valves must fit the guide well in order that there will not be any leaking of air into the cylinders. The valve guides should be inspected and repaired, if they are found too loose.

Now for the pistons. If you have had to rebore any of the cylinders, make careful measurements of the new diameter. Piston rings about .005 in. oversize should be selected and at least the two top rings should be replaced, for heat and wear undoubtedly have reduced the tension of



**Testing clearance with a feeler gage while fitting piston ring into place**

the old rings. Be sure that all parts are covered with a film of oil before being replaced.

Broken or worn valve lifters should be replaced with new ones, as they might become a source of much trouble. If the valve has worn a hole in the top of the adjusting screw, reface the screw on a grinder so that measurements with an adjusting gage can be made.

An important point to remember is that the timing gears must be replaced in a definite position. If you have followed the directions previously given, you will have the gear marked. The flywheel markings will assist in checking the setting of the timing gears.

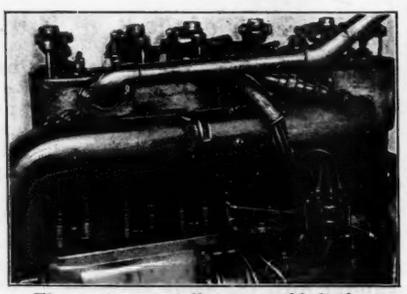
You will now have the engine complete and set in the frame. The next step will be the addition of the accessories.

Inspect the carbureter float for leaks by placing it in boiling water. A hole will be easily discernible. If there is some liquid within, punch two holes in the float, drain off the gasoline, and solder the holes shut. A cork float, if very old, may have become soggy. Test its floating qualities before putting it back in the carbureter.

The vacuum tank float must be examined in the same way. Scale will sometimes form at the bottom of the tank and dirt may lie loosely near the outlet. After cleaning the parts and seeing that the valves work easily, assemble the tank, being sure that the gasket is good and the tank airtight.

Wash out and clean thoroughly all gasoline lines and the main supply tank. Run a fine wire through all small nozzles and passages to remove any obstructions that might be there.

The gasoline system should then be clean from tank to cylinder. Put it together and start on the ignition system. Dismantle the generator and inspect the wiring and other visible parts. See that the brushes are in good condition and



**The engine partially reassembled after the worn parts have been replaced and the whole thoroughly overhauled**

replace any that are not good. In making replacements, be sure that you sand them in to fit the surface. See that the insulation is not worn out at any point. A bit of tape added here and there will help.

It may be necessary to remove the commutator, turn it on a lathe, and cut the mica between the segments down 1/32 in. below the surface to prevent the brushes from riding on them. This can be done with a hacksaw blade. Then

(*Turn to page 102*)

# The Merriest Christmas of All—

BRIGHT and early Christmas morning you and your boy will be running his Lionel Train, enjoying the thrills of the world's most fascinating and educational toy.

Lionel Trains and Miniature Railroad Equipment are exact reproductions of those used on America's leading railroad systems.

Lionel Locomotives are powerful enough to haul a train of twenty or more cars around curves, through tunnels, over bridges and across switches.

The realistic Lionel equipment includes Crossing Gates that automatically lower as the train approaches and raise as it passes by. Electric Block Signals flash "Danger" and "Clear Track Ahead," while Electric Warning Signals ring at the crossings.

All Lionel Locomotives, Cars and Accessories are of steel construction and practically indestructible.

For 23 years Lionel Electric Trains have been electrically and mechanically perfect and fully guaranteed. They are attractively finished in rich enamels and baked like automobile bodies.

You can buy a Lionel Electric Train Outfit for as low as $5.75. Or your boy can start his Lionel Railroad System with a larger locomotive and track and add to it. A Lionel Outfit is good for years and years of fun and happiness so there is real economy in buying it.

Lionel Trains can be operated from any light socket with a Lionel "Multivolt" Transformer —or from dry cells or storage batteries.

You can see Lionel Trains in operation at the best toy, hardware, electrical, sporting goods and department stores.

Send for the new 48-page Lionel catalogue—a handsome book showing the complete line in colors. It's free.

***Lionel "Multivolt" Transformers***

give unlimited power at very little cost. They are best for operating Lionel Trains. Safe—efficient — economical.

*Insist on Lionel Accept No Substitute*

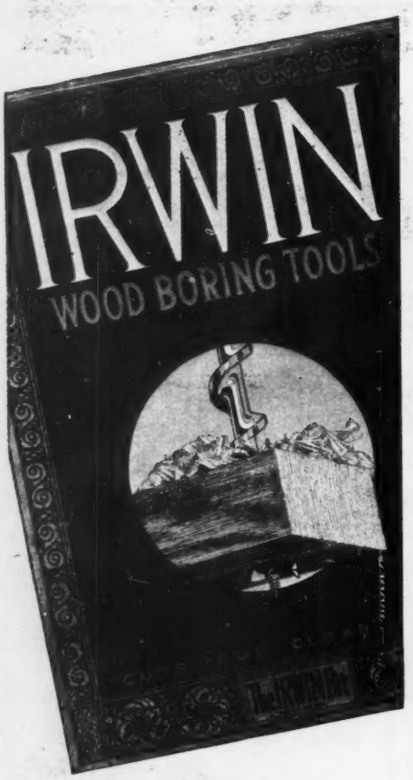
**THE LIONEL CORPORATION**

**48-52 East 21st Street Dept. 15 New York City**

*"Standard of the World" Since 1900*

# LIONEL ELECTRIC TOY TRAINS

*& Multivolt Transformers*




# "the best book I've ever read on wood boring tools"

"It contains the very information I've often wanted, but didn't know where to get. Your complete description of bits and augers and the simple explanation of how and why they "bore," have made plain to me the reasons for the birth of the Bor Family."

The above is only one of the many unusual comments received on our new catalog. In fact, it is more than a catalog—it is a practical working manual on the selection, use and care of bits and augers. If you haven't a copy, write today, giving name and address of your hardware dealer.

*To Hardware Dealers*: You, too, should have a copy of this book. If you haven't received it, send us your name today.

**Address Dept. 112**

**The Irwin Auger Bit Co.,**
**Wilmington, Ohio**

*Originators and sole manufacturers for more than 30 years, of the Genuine Irwin Bits and Augers.*

The IRWIN Bit
Reg. U.S. Pat. Office

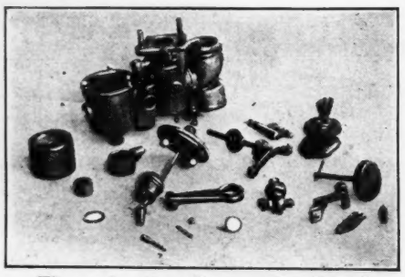
## How to Rebuild an Old Car

(*Continued from page 100*)

see that all bearings are in good condition and put in a good supply of grease and oil before reassembling the generator.

Test the generator with a battery to see whether it will run as a motor. If this works, it is reasonable to assume that it will work as a generator. When running on the engine, the third brush can be set and other regulations made so that an amperage of from 10 to 14 is obtained on a 6-volt system and from 5 to 7 on a 12-volt system. In the same way inspect and repair the starting motor, but do not undercut the commutator.

If the ignition is of the battery type, inspect the distributor, coils, and other parts, testing each carefully. New points

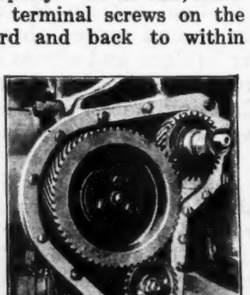


**The carbureter taken apart, cleaned and inspected, ready for reassembling**

are frequently necessary on the distributor, but if they are only pitted, they may be honed or ground down to a new and true seat. It is well to renew all high and low tension wires, as the added expense is negligible as compared with the increased efficiency of the system.

If a magneto is in use as a source of ignition, it should be completely dismantled and all brushes and moving parts carefully checked. The points on the breaker mechanism of the magneto are platinum and very expensive. They are also softer than the tungsten used in battery distributors and are easily filed to a new seat.

Test the reassembled unit to see that it will generate properly. To do this, run a wire about the terminal screws on the distributor board and back to within ¼ in. of the frame of the magneto. When twirling the rotor by hand, a spark of sufficient intensity to jump the gap should be produced.



**The engine timing gears**

Now connect all wires from generator or magneto to spark plugs and call the ignition system finished, for the battery is something that cannot well be repaired at home. It should be sent to a battery shop for recharging before being installed in the car.

The water pump, as a rule, does not require much attention, excepting that

(*Turn to page 103*)

# Coal too High? Science Says "Burn Free Air"

**New Discoveries Make it Easy to Keep Homes Warm in Coldest Weather**

No more paying exorbitant prices for coal. No more hauling and chopping wood. No more shivering in wintry weather waiting for fire to be built. Wonderful new device **Nu-Heat** takes one part of coal oil, or kerosene (the cheapest fuel known) and combines it with TWENTY parts of air (the only FREE fuel). Makes a cheaper gas than city gas. Gives intensely hot, cheerful flame almost instantly. Warms the largest rooms on "blizzardy" mornings in a few minutes.

**A Warm House as Soon as You Arise-Cuts Housework ½**

AT TWIST OF WRIST-FIRE READY IN FEW SECONDS

**ROOMS WARM IN 5 MINUTES**

Good, steady heat for perfect baking. Fits any stove, range or furnace. Stop handling coal and wood and cleaning out ashes, dirt, dust and soot. Government Experts and Domestic Scientists advise everyone to burn Nu-Gas. Absolutely safe. Ironclad guarantee, 30 days' free trial. Stop burning coal—burn free air. Stop building fires—HAVE one in few seconds. Write for free information today. Mention if you have range, heater, furnace.

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Make $50 to $200 a week. Full or spare time. Personal cooperation. Free sample case offer. Write quick for exclusive territory.

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Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., for October 1, 1923, State of New York, County of New York, ss. Before me, a notary public, in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of Popular Science Monthly and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in Section 443, Postal Laws and Regulations, printed on the reverse of this form to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, The Modern Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Editor, Sumner N. Blossom, 225 West Thirty-ninth Street, New York, N. Y. Managing Editor, Sumner N. Blossom, 225 West Thirty-ninth Street, New York, N. Y. Business Manager, O. B. Capen, 225 West Thirty-ninth Street, New York, N. Y.

2. That the owners are: The Popular Science Publishing Company, Inc., 225 West Thirty-ninth Street, New York, N. Y. Stockholders of Popular Science Publishing Company, Inc., Henry J. Fisher, 22 William Street, New York, N. Y.; Oliver B. Capen, 225 West Thirty-ninth Street, New York, N. Y.; Robert Cade Wilson, 683 Springfield Avenue, Summit, N. J.; George B. Agnew, 22 William Street, New York, N. Y.; Susan D. Bliss, 22 William Street, New York, N. Y. 3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of the total amount of bonds, mortgages, or other securities are: none. 4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

(Signed) O. B. CAPEN, *Business Manager*.

Sworn to and subscribed before me this 19th day of September, 1923.

Paul M. Bone.
(Seal) My Commission expires March 31, 1924.

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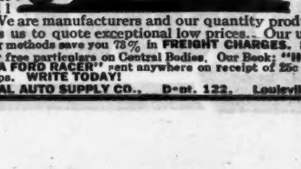


UNDER SLUNG PARTS Per Set $6.75

CENTRAL AUTO SUPPLY CO., Dept. 122, Louisville, Ky.

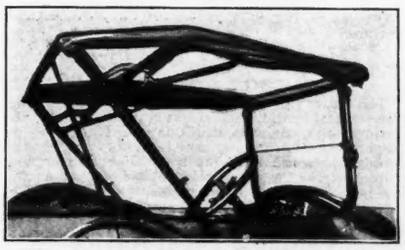
## How to Rebuild an Old Car

(*Continued from page 102*)

occasionally it may be necessary to replace the packing. Back off the two nuts and replace with new pump packing. Also see that the paddle is not loose on its shaft.

The painting should be carried on at the same time as the assembling so as to give the several coats ample time to set. Each unit should receive one or two coats of gray or black enamel. Then the body should be placed where dust cannot settle on the soft painted surface and rubbed down thoroughly with No. 00 sandpaper. Flow one or two coats of good body enamel.

The top and curtains should be given a coat of top dressing and the leather upholstering should receive a coat of seat dressing. It is a good plan to loosen the covering, webbing, and padding and stretch all parts tightly if the top is not too worn and can be used again. The



**The quarter padding and webbing of the top tightened and ready for covering**

surplus material can be cut away and the edges bound with new gimp and welt, held in place with new tacks.

With the car completely assembled, the first thing to do is to see that all cotter keys are secure and no parts have been left off or are loose. Then put a man on the crank and another on the starter.

Be sure that there is a sufficient supply of good oil in the crankcase before starting. If the engine starts, but splutters and coughs, do not be too alarmed, for a little running will take that out of the motor. When it has started running, take an oil gun and shoot some oil into the air intake of the carbureter so that the piston and upper part of the cylinder will receive proper lubrication.

If the oil pressure gage on the dash shows no pressure, prime the pump after stopping the engine. Then run cold water into the radiator, drawing off the warm water through the bottom petcock.

Continue to run the engine slowly for about two hours with the water running through the radiator. Shoot a little oil through the carbureter occasionally. If the engine seems exceptionally stiff, place a quart of lubricating oil in each 5 gal. of gasoline for the first 300 to 500 miles. Do not drive over 25 miles an hour for at least 500 miles and replace the oil at the end of the first 100 miles, again at the end of 250 miles, and thereafter every 500 or 700 miles.

If you have carefully followed the directions given in the last two numbers of POPULAR SCIENCE MONTHLY, you should have a first class, reconditioned car that will serve you well for another 25,000 miles.

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## Home Workshop Chemistry

*Simple Formulas that Will Save Time and Money*

BY TAKING one simple precaution, the home worker can insure his varnish finishes lasting a long time in their original clearness and beauty. Just brush a little denatured alcohol on the wood before the filler or varnish is applied. This will "kill" any possible bad effects caused by albumen and thus lengthen the life of the varnish.

The albumen content of a wood is the chief source of trouble in the disintegration of varnishes. An open grained wood contains far more albumen than a close grained specimen and therefore a varnish lasts for a greater length of time on a close grained wood. Since some of the shellacs, substitutes for shellac, as well as certain varnishes and some fillers contain free alkali in the form of potash, this potash, on coming in contact with the albumen, forms a white, brittle compound that has a destroying influence. For this reason, if for no other, only the best varnishes on the market should be bought.

**Removing softened varnish with a scraper**

In removing varnish from old furniture, however, the presence of albumen in the wood and in the oil sometimes used in compounding finishes, is an aid. It makes possible the softening and easy removal of the varnish by potash, sodium carbonate, and other alkali.

All that has to be done is to dissolve one of these substances in water so as to make a strong solution and then soak the varnish thoroughly with the aid of a rag or sponge. After a few minutes, the varnish will be soft enough to be easily scraped away with a blunt knife or scraper.

Oak sometimes gives trouble because it contains tannin, a very active substance that has a softening effect on some varnishes. It has good points, however, when certain types of water stains are used. The softer gums and, to some extent, shellac seem to have a softening effect on woods containing tannin.

A teaspoonful of potassium chromate, an ounce of which is usually sufficient to keep on hand for all purposes, dissolved in a pint of water is an excellent yellowish brown water stain that is quite lasting when brushed on oak, walnut, mahogany, and other woods containing tannin. But this stain can not be used on pine, fir or cypress, since these woods contain only minute amounts of tannin.

A silver gray stain is prepared by first dissolving a teaspoonful of pyrogallic acid (the photographer's pyro, obtainable through dealers in photographic supplies)

(*Continued on page 105*)

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## Home Workshop Chemistry

(*Continued from page 104*)

in a glass of water, and applying with a brush. When dry, a second coat is given by dissolving a teaspoonful of ferrous sulphate (green vitriol) in another glass of water.

A bluish black stain can be prepared by mixing a half teaspoon of potassium permanganate, a half teaspoon of potassium bichromate, and a teaspoon of pyrogallic acid together with a quarter of a teaspoon of ferrous sulphate dissolved in a glass of water. The color can be deepened on increasing the quantity of pyro. Then the color will approach that of ebony.

To prevent the wood from roughening, it is first moistened with water, allowed to dry, and is sandpapered. The water stain will not then raise the grain.

All water stains must be left at least 24 hours to dry, during which period the color will develop and deepen. Then the wood may be slightly oiled with a very small quantity of linseed oil, and, when this is dry, it can be shellacked or waxed.

**Mixing an ebony stain for woodwork**

Turpentine stains are seldom permanent; they quickly fade away.

In making a shellac varnish stain, it is always best to color the alcohol to the desired shade before the lac is added. Many spirit soluble dyes and vegetable coloring matters, such as saffron (yellow), sandalwood (dark red), madder (reddish brown), tumeric (orange yellow), and analine dyes, may be used.

The wearing qualities of a varnish depend upon the hardness of the resin and the liquid in which it is dissolved. For the best results it should be applied only to smooth, clean surfaces; it should not be put on too thick, as it becomes waxy, and not too thin, as it then shows no gloss.

A cheap floor varnish consists of 1 pt. turpentine in which 1 lb. common resin is dissolved by gentle heat. Then 2 qt. of boiled linseed oil are added. Another varnish, more durable and just as easy to make, consists of ¾ lb. alcohol soluble manila copal, 4 lb. purified shellac, ¾ lb. Venetian turpentine, and 1¾ gal. alcohol. If the Venetian turpentine cannot be obtained, ozonized or oxidized turpentine can be used, but under no condition employ the substance usually sold in paint stores as turpentine or spirits of turpentine.—ERNEST BADE, Ph.D.

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ALTHOUGH wood that has to be stained and finished with shellac, wax, or varnish must always be sandpapered with the grain, it is often much better to finish pine or whitewood that is to be painted by rubbing it with sandpaper diagonally or across the grain. The tearing of any very spongy and soft wood may be prevented by giving the wood a coat of size made by mixing hot water with a small quantity of glue. Do not rub the sized surface too rapidly or the glue will soften and gum up the sandpaper.


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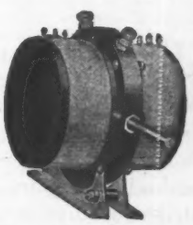

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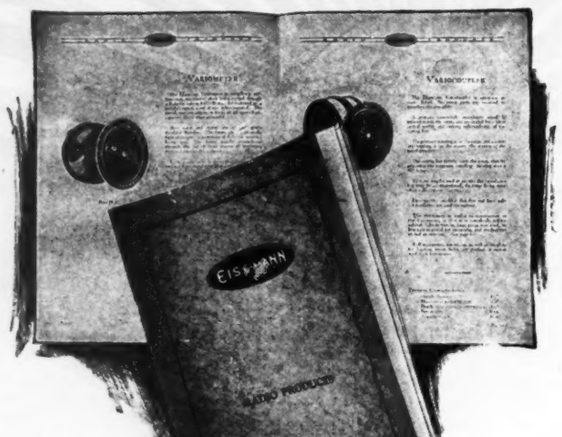


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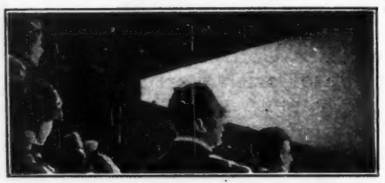

WHEN "bedtime stories" and fairy tales are shown on the wall—when the whole family can enjoy snapshots, postcards and the like—you'll realize what an entertaining Christmas gift is a

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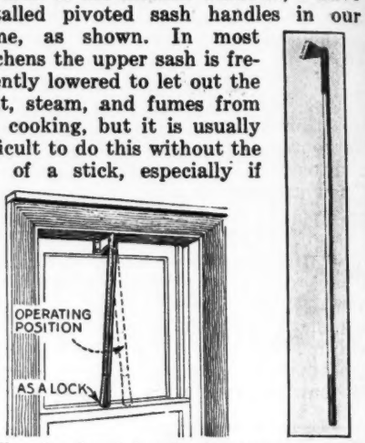
## Handle for Lowering Upper Sash of Kitchen Window

FOR raising and lowering the upper sash of the kitchen windows, I have installed pivoted sash handles in our home, as shown. In most kitchens the upper sash is frequently lowered to let out the heat, steam, and fumes from the cooking, but it is usually difficult to do this without the aid of a stick, especially if there is a sink, table, or other furniture in front of the window.




**The dowel-rod handle is pivoted to a small brass bracket on the upper sash**

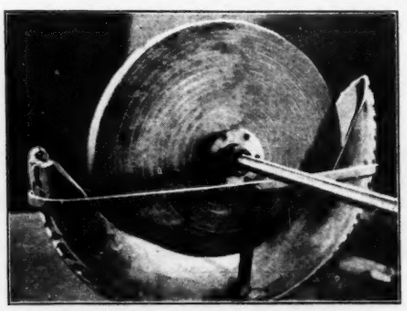
The handle illustrated is made from a 5/8-in. dowel rod slotted at one end and pivoted to a bracket made from a piece of 13-gage brass. The wood is stained and varnished.

The rod is just long enough to push in on the top of the lower sash and it therefore serves as a lock when the window is closed.—W. T. MARKOWSKI.

## Old Tire Serves as Trough for a Grindstone

INSTEAD of constructing a drip or the usual trough beneath the 30-in. power grindstone illustrated, the owner used an old 40 by 8 in. tire picked from his junk pile. He first cut off the beads with a sharp, heavy knife, forced through the fabric with a hammer. Then he cut the tire in two and rounded off the ends of one of the halves.

This half was mounted beneath the stone by nailing it to one of the posts that support the bearing. As an additional support for the tire, a frame of thin strap iron was made as shown. There is about 1 in. clearance between the bottom of the stone and the inside bottom of the tire.



**Not only is the tire a good trough, but it also prevents water from splashing**

This idea works well. The tire extends so high about the grindstone that it serves as a guard. Practically no water is thrown out and lost.—PERRY D. WILSON.

## Making Toys for Christmas

(*Continued from page 79*)

finishing, as the enamel should be of a kind that can stand considerable rough handling and washing. If a first class enamel of the color desired cannot easily be obtained, get a good white or cream enamel, and tint it with artist's oil color in tubes, which can be obtained in any color.

The checkerboard should be laid out in pencil on the tray top or bottom, the latter being better if the table is to be used only occasionally for games. Make it 12 in. square and color the squares alternately red and black with a reliable oil paint.

The toy garage is a boy's toy. It can be used either as an independent plaything or regarded as an addition to a doll's house, if the children have one. It is intended as a companion piece to the doll's house described in the Home Workshop a year ago, and detailed in Home Workshop Blueprint No. 14.

Wood strips and wallboard are used in building the garage. It is 18 in. wide, 20 in. long, and 18 in. high. The sides are 12½ by 19½ in. wallboard, and the front and back 18 by 18 in. The corner posts are 1⅛ by 1⅛ by 12½ in.; there are 14 rafters ¾ by ¾ by 10¾ in. and a crown ⅞ by 1¼ by 23 in. The front doors are two pieces of wallboard 3 by 10 in., and the side door is 3½ by 6 in. Small strips of ¼-in. stock form the trim for the garage and doors.

### *How to Finish the Garage*

The garage should be neatly painted and the trim picked out in appropriate harmonizing or contrasting colors.

To furnish the garage with a toy auto, use one of the larger and better commercial toy cars or carve a body from soft wood and fit it with four wheels and a "spare."

The little wheelbarrow is a toy for the smaller children, very easy to make when the pattern for the sides is laid out. Painted up realistically, it makes a pretty toy. At the same time it has all the advantages of a regular wheelbarrow from the standpoint of the small boy, who likes nothing better than to cart his possessions around from place to place.

The sides are cut with a compass or keyhole saw (or a fret-, band-, or jigsaw, if available) from pieces ¾ by 10 or 12 by 30¾ in. The bottom is ⅞ by 9¾ by 12¼ in.; the headboard ⅞ by 6½ by 8½ in.; and the tailboard ¾ by 2½ by 12 in. The axle is 1½ by 1½ by 9½ in. and should be of hard wood. The wheels are ⅞ in. thick and 8 in. in diameter. Two iron rods about 5/16 in. in diameter and 10 in. long, with nuts, hold the head together, and one rod 14½ in. long, the tail.

Full working details and complete lists of materials for all three toys are contained in POPULAR SCIENCE MONTHLY'S Blueprint No. 29. This can be obtained from the Blueprint Service Department, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York, for 25 cents. A complete list of blueprints previously issued is printed on another page.

# The size you want— the insulation you need

YOU don't need to wait while your panel is cut to order when you get ready to build your radio set. Just go to your dealer and ask for a Celoron Radio Panel. He will give you, without a moment's delay, the exact size you want. And—what is more important—you get the proper insulation for successful results in radio receiving.

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| 3—7 x 12 x ⅛ | 7— 7 x 24 x 3/16 |
| 4—7 x 14 x 3/16 | 8—12 x 18 x 3/16 |

We also furnish Celoron in full sized sheets and in tubes, and can cut panels in special sizes when desired. If your dealer hasn't yet stocked Celoron panels, ask him to order for you, or write direct to us, indicating by number the size you want.

***Send for free booklet***

"Tuning In On a New World" is the title of a booklet we have prepared especially for the radio fan. It contains a list of the leading broadcasting stations in the United States and Canada, an explanation of symbols used in radio diagrams, and several popular radio hook-ups. This booklet will be sent without charge, on request.

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## Working Drawings for Useful and Novel Christmas Gifts

BESIDES a large variety of designs for useful Christmas gifts in this month's Home Workshop, you will find some unusually attractive pieces of furniture, toys, and other gifts listed below among POPULAR SCIENCE MONTHLY blueprints. Note particularly the Pullman play table (No. 28) and the toy train, horse, and house (No. 14); the kitchen cabinet work table (No. 27) and the kitchen cabinet (No. 5); the gateleg table (No. 24), the Colonial writing desk (No. 21), the sewing table (No. 1), the smoking cabinet (No. 2), and the two-stage radio receiving set (No. 6).

Having a good drawing or design to work by is half the battle. It will do more to insure success in your home workshop than any other single item. The tendency of many amateur mechanics is to start out to build something with little more than a general idea of the design in their mind or at best a very rough sketch. As a result, there is no efficiency or method in the construction, time is wasted in checking up details that should have been foreseen at the very beginning, and the builder's skill and patience are tried. All this can be avoided by having a fully detailed plan in the beginning and a list of materials.

For any project other than the most elementary, the home worker will find it is best to make a careful drawing and list of materials, or to make use of blueprints such as those in the Home Workshop series.

## Complete List of Blueprints

ANY one of the blueprints listed below can be obtained from POPULAR SCIENCE MONTHLY for 25 cents. The Editor will be glad to provide, upon request, information relative to tools, material, or equipment.

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| 14. | Toy Train, Horse, and House | 25c | ☐ |
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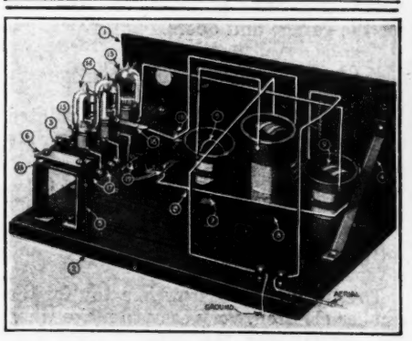
# John Davey *needs young men*

John Davey's organization, The Davey Tree Expert Co., Inc., has a limited number of openings for ambitious young men between 20 and 30 years of age, single men preferred. The opportunity is unusual, offering good pay at the start, permanent employment in the Davey organization, and thorough scientific training in the profession of Tree Surgery. Advancement rapid, according to merit. The work is fascinating, offers chance to travel extensively, and association with fine fellows. Only clean, red-blooded young Americans, lovers of the outdoors, need apply. Write, giving full information to The Davey Tree Expert Co., Inc., 55 City Bank Bldg., Kent, Ohio.



## Make Your Own
# RADIO
## Receiving Set

Use a blueprint of this two-stage regenerative receiving set with two stages of amplification, which, under favorable conditions, if a long high aerial is used, will receive 500 miles.

The blueprint is easy to understand and contains working drawings, instructions, and bill of materials.

**Price 25 cents**

## Radio Map of the United States

With Dictionary of Broadcasting, Government and Commercial Stations, Call Letters, Wave Lengths, etc.

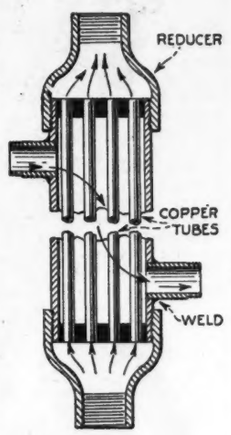
**Price 35 cents**

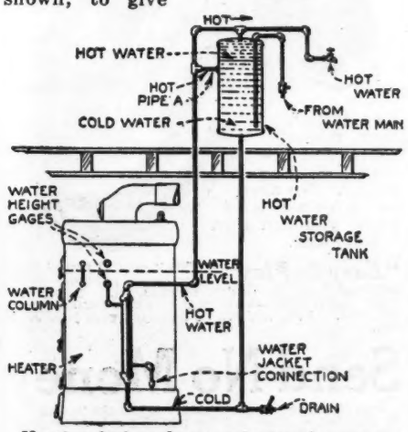
## Popular Science Monthly
**225 West 39th Street New York City**

## Using Steam from House Boiler to Heat Water

WHEN a steam-heating plant is used to heat water for the house water system, the usual practice is to place a coil of pipes at one side in the combustion chamber. This is objectionable because in small firepots one side of the water jacket is made less efficient and the coil itself is often in the way when the fire is being stoked. The heating device illustrated was made to avoid these difficulties, and it gives a very quick and hot flow of water.

It is made from ordinary pipe, pipe fittings, and copper tubes. The ends of the large pipe are closed and sufficient tubes are placed in it, as shown, to give




**Heating device (above) and general arrangement of the water heating plant (below)**

the same area as the area of the outlet pipe. The space around these tubes is connected with the water jacket of the boiler by a short pipe, as indicated. Therefore water at very nearly steam temperature constantly surrounds the copper tubes. Cold water enters the tubes from the bottom and in passing up through them becomes hot.

This heater is connected in the usual way with the storage tank, except that the pipe leading into the tank just above the center is an improvement over the regular method.—PAUL H. BYER.

## Capping Tool Handles

A WOODEN tool handle can be fitted easily with a leather cap. Cut off the top squarely to form an even bearing for the leather and then cut a piece of sole leather to suit. Glue this to the top of the handle and fasten with half a dozen shoemaker's tacks. The end of the wood can't come through a handle of this sort, and if carefully made, it will last for years.—B. Y.

An Appreciated Gift

**Charges Radio and Auto Batteries at Home Over Night - For a Nickel!**

For a friend who owns a radio set or automobile, what could be more appropriate than a gift which would eliminate the inconvenience and expense of taking his battery to a service station every time it requires recharging? The

GOLD SEAL HOMCHARGER
The World's Most Popular Battery Charger

is such a gift, appropriately dressed up in a beautiful Christmas package, too. It charges any AUTO, RADIO or "B" storage battery in the simplest, quickest and most efficient manner possible. Connects to any lamp socket—operates silently—requires no watching. Fully automatic in operation—absolutely safe.

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1. **Simple**—Only one moving and wearing part, replaceable after thousands of hours use for $1.00. Will last a lifetime.
2. **Efficient**—Uses less than one-half the current of any bulb or liquid type rectifier. Will charge any radio or automobile battery for a nickel.
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6. **Fool-Proof**—Can be operated by anyone. Attach to lamp socket and connect battery either way, it will always charge. High-grade ammeter eliminates guess work.
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8. **Beautiful**—Mahogany and Gold Finish.
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Your Skin Can Be Quickly Cleared of Pimples, Blackheads, Acne Eruptions on the face or body, Barbers Itch, Eczema, Enlarged Pores and Oily or Shiny Skin.

FREE Write today for my FREE BOOKLET, "A CLEAR-TONE SKIN," telling how I cured myself after being afflicted 15 years.

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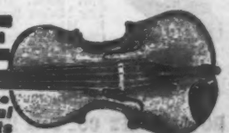

$20 Fine Tone Musical Instruments

We have a wonderful new copyrighted system of teaching note music by mail! To first pupils in each locality we will give free a full superb Violin, Tenor Banjo, Ukulele, Hawaiian Guitar, Banjo, Mandolin, Banjo-Ukulele, Banjo-Mandolin, Cornet or Banjo-Guitar absolutely free. Also teach Piano and Organ. Very small charge for lessons only. Four lessons will teach you several pieces. Over 100,000 successful players. We guarantee success or no charge. Complete outfit free. Write today. Dept. 148. No obligation.

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"SEE that coupon? Remember the day you urged me to send it to Scranton? It was the best thing I ever did.

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"Then he asked me if I thought I could take over Bill Stevens' job. I told him I was sure that I could—that I had had that goal in view ever since I started my I. C. S. course.

"I start to-morrow, Mary, at an increase of $60 a month. It's wonderful how spare-time study helps a man to get ahead."

FOR thirty-one years, the I. C. S. has been helping men to win promotion, to earn more money, to get ahead in business and in life.

You, too, can have the position you want in the work you like best. Yes, you can.

All we ask is the chance to prove it. Without cost, without obligation, just mark and mail this coupon.

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Without cost or obligation on my part, please tell me how I can qualify for the position or in the subject *before* which I have marked an X:

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**HOW TO CONDUCT A RADIO CLUB**
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Covers parliamentary procedure, indoor and outdoor experiments, 5,000 mile receiving sets, vacuum tube amplifiers and detectors and many other subjects.
148 pp. Fully illustrated. **Price 75c**
**POPULAR SCIENCE MONTHLY**
**225 West 39th Street** **New York City**


## Craftsman's Table Lamp Has Art Glass Shade

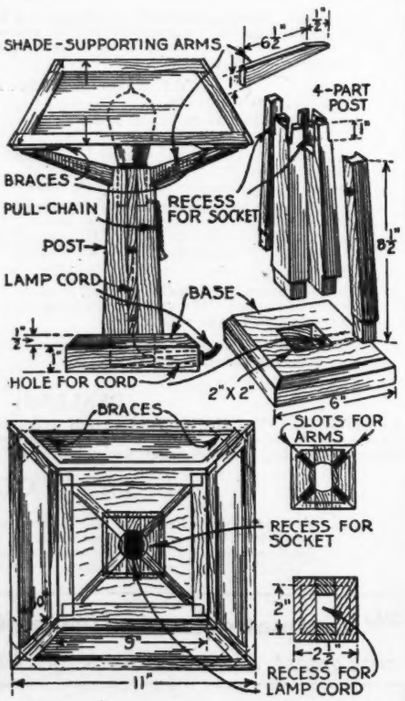
**By James Ellis**

THIS table lamp, because of its simplicity of line, displays to unusual advantage an art glass shade. The pedestal and shade frame can be made of mahogany, gum, or any wood that can easily be worked, and they can be put together with very few tools.

**The lamp is of mahogany and red art glass**

If the lumber is bought, a ⅞-in. board about 2 ft. long will make all the parts. The base may be cut from a thicker piece or glued up from thin stock. It is chamfered on the upper edges and has a mortise to receive the column and a hole for the lamp cord.

The column is made of four pieces glued together, mainly so that the recess for the socket can be worked out with less trouble, but it can be shaped from a solid, glued-up piece. A regular pull socket is used, but the brass outer shell is discarded and the fiber cover is glued in the socket recess when the column is assembled. A hole for the chain is bored through one of the sides. The wiring is carried through a central hole to the base before the column is glued together.




**Side and top views of the lamp and details of the base, pedestal, and arms**

At the top of the column four slots are sawed, one at each corner, to take the arms that support the shade. These arms are made tapered and are set into the column at a slight angle.

*(Continued on page 111)*


# Play this Jazzy Sax *Without Practice*

No Lessons
Sweet Jazzy Tone

Not a toy—but a real musical instrument. *Glistening, polished brass* with nickel mouthpiece. Looks like a regular saxophone the same size. Weighs over 3 lbs.

Anyone can play this imported Jazzy Sax right away. No knowledge of music required, no lessons. Play by numbers instead of notes—play by notes or ear if you wish. *All directions and 30 songs free!* Be popular at parties, dances, picnics.

Beautiful, clear, ringing tones and delightful harmony. No need to spend $85 when you can own a Jazzy Sax.

***"Easy to Play"*** "This is easy. I played tunes after fifteen minutes and am delighted."—V. D. Beatty, Chicago, Ill. "I find your Jazzy Sax is very easy to play."—Clara Lemke, Appleton, Wis. You, too, will be delighted with your Jazzy Sax.

# Send No Money

Just fill out the coupon below. When the Sax and the 30 Free Songs arrive, pay the postman only $5.98 plus a few pennies postage. Play the songs right away. You don't risk a penny. *Satisfaction guaranteed or money refunded.* But the supply is limited—so don't delay. *Mail the coupon today.*

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BY RAYMOND FRANCIS YATES. The treatise covers all of the essentials of elementary chemistry. The second part of the book is devoted to chemical and electro-chemical experiments. **Price, 75 cents**

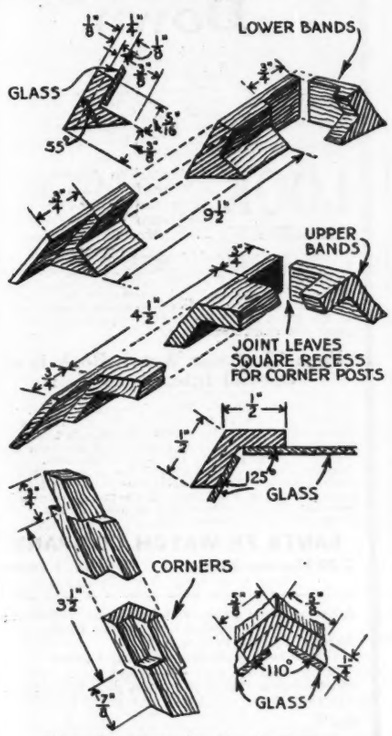
**Popular Science Monthly**
**225 West 39th Street** **New York**

## Craftsman's Table Lamp

(*Continued from page 110*)

Although it seems rather formidable, the shade is really not difficult to make. If a protractor or bevel is not among the tools available, the frame should first be laid out full size on paper. The main angles are cut at 60 degrees and the joints are made in the fashion of a half lap, the tongues being ⅛ in. thick. The cutting is done on the inside, where the glass goes. The outer angles can be planed, but the inside will have to be finished with a chisel.

The shade frame is assembled by gluing together two panels and letting them dry before putting on the connecting pieces.




**How the pieces for the shade frame are cut out and put together**

If the lengths have been laid off accurately, and the angles cut carefully, they should go together without any trouble. They should be clamped and left overnight for the glue to harden.

Since all of the bands are made the same length, it is necessary to trim off the ends of the bands glued first, so that the remaining bands will go on properly. A file is a most useful tool for the delicate fitting and lapping, as the depth of the laps is only ⅛ in.

A place on the bench is cleared off for the final assembly, so that the corners can be tried with a square and thoroughly checked for trueness before the joints are clamped or tied together.

At each corner of the shade a small piece of wood is glued to take a small wood screw passing up through the end of each arm.

The lamp should be stained and finished as desired before the glass is set. The glass is bought cut to the exact sizes and is put inside the shade with small nails, wood screws, glazier's points, putty, or sealing wax.


*Special Offer*

**$6.95**

Regular Value $10.00

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**All Wool Heavy Sweater**

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This is a splendid big sweater at a bargain price. Every fibre pure wool. Heavy rope stitch. Large fashioned shawl collar. Two large lined pockets. Close knitted wristlets. Ivory buttons to match. Made in big, full size, in rich fast colors. Nothing so practical for fall and winter wear. Sold by most stores for $10.00, all spot cash. Sizes 34 to 46. Colors: Dark Maroon or Navy Blue.

Order by No. F-12. Send $1.00 with coupon. $1.00 monthly. Total $6.95.

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Buy the Elmer Richards way, on credit, as thousands of well satisfied men do. Everything you need in clothing or shoes and you pay in small monthly sums. Open a charge account with us. No charge for credit. One price only. Strictly dependable qualities.

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Don't miss this bargain. The supply is limited. You take no risk. We stand back of this sweater. Money back if you say so. Compare our prices with cash prices in retail stores. Send the coupon now with $1.00. Don't be too late for this Special Offer. Send the coupon NOW.

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I enclose $1.00. Send Heavy Wool Sweater No. F-12. Size..... Color.....

If I am not satisfied when I receive the sweater I can return it and get my payment back with charges. Otherwise, I will pay the advertised terms, $1.00 with coupon, $1.00 monthly. Total price, $6.95.

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- What radio equipment you will need
- How you assemble your receiving set
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- What radio stations you can hear
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**The Standard RADIO GUIDE**

**May Save You $5.00 to $50.00**

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## METAL CUTTING SAWS

## Do Your Work Faster—Easier

TRY an Atkins Non-Breakable Blade in your hack saw frame. It will saw the toughest metal faster and easier than ordinary blades, hold its cutting edge longer, and will not break.

There's a reason. These blades are made of selected steel, and are hardened and tempered by an exclusive gas-and-oil process, which gives a hard, keen cutting edge and a tough, flexible body.

You can eliminate losses of time and money due to breakage of brittle blades by using Atkins Non-Breakable Hack Saw Blades. Prove it for yourself. Send ten cents and tell us what metal you want to cut, and we'll send you a sample blade.

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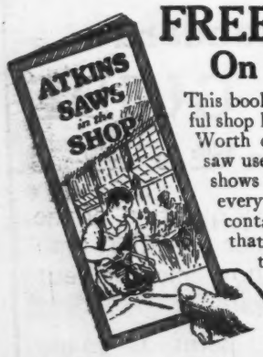
When you need a hand saw, circular saw, band saw, pruning saw, metal cutting machine, or *any* saw for cutting wood or metal—there's an Atkins product that will save time, money and labor. Write for free booklets on the saws you need.




### FREE Book On Saws

This book is full of helpful shop hints, and tables. Worth dollars to every saw user and buyer. It shows the right saw for every purpose and contains suggestions that will save you time, energy and money. Write us for your copy, NOW.

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***Makers of Silver Steel Saws and Tools***

## Old Electric Lamp Makes Novel "Crystal" Gazing Globe

CRYSTAL gazing globes, sometimes used by seers and mind readers, cost from $5 for the cheapest glass to $500 for the larger, highly polished crystal ones. An excellent substitute, which can be made in the home workshop almost without cost, will give just as much amusement as an expensive globe and can be easily "doctored" to provide mysterious "visions."

The "crystal" globe

The writer made the "crystal" illustrated from an old, sphere-shaped, tipless electric light globe. The copper shell at the end was removed and a tiny hole was filed into that part of the globe formerly covered by the metal. Air was admitted gradually so as to avoid breaking the bulb. A ring was then filed around the socket part, next to the globe, and the sphere shaped part broken off by gently tapping it. Fitted and glued to a turned wood base, the sphere forms an excellent gazing globe.

The diagram shows how a special base was constructed to give entertainment to friends. It was made of a 4-in. length of cardboard mailing tube, covered with black velvet and glued to the wooden base and to the globe. Inside the tube is a small flashlight battery which supplies current to a light when a button switch, concealed under the velvet, is pushed.

The light illumines a transparent picture and causes it to appear in the

**Hidden flashlight causes mystic materialization to appear in globe**

globe, as if a materialization in a séance. The opening beneath the globe for the reflection should be small and hidden as much as possible by the velvet.

A picture to suit the "medium's" purpose is drawn on glass or celluloid or a transparent slide, as for a magic lantern, or is made from a photograph.

---

BEFORE putting a paint brush away wash it thoroughly with kerosene, and while still soaked, wrap it in waxed paper. Use turpentine, gasoline or benzine to wash it out before using it again.

## No Money Down

While other watch dealers are raising their prices, asking you for larger monthly payments, and making payment terms harder for you to meet, we are offering you our new model Santa Fe Special, no advance in price, no money down, easier terms and smaller monthly payments. WE realize the war is over and in order to double our business we MUST give you pre war inducements, better prices, easier terms and smaller payments.

**LOOK** *Adjusted to Positions*
*Adjusted to Temperature*
*Adjusted to Isochronism*
*Adjusted to the Second*
*Thin Model. All Sizes*

Without one penny of advance payment let us place in your hands to see, to examine, to inspect, to admire, to approve, a real masterpiece in watch creation. A Watch which passes the most rigid inspection and measures up to the exacting requirements of the great Santa Fe Railway System, and other great American trunk lines.

**Page 12 of our Watch Book is of Special Interest to You**

Ask for our Watch Book free—then select the Watch you would like to see, either the famous Santa Fe Special or the 6 position Bunn Special, and let us explain our easy payment plan and send the watch express prepaid for you to examine. No Money Down. Remember—No money down—easy payments buys a master timepiece—a 21 Jewel guaranteed for a lifetime at about half the price you pay for a similar watch of other makes. No money down—a wonder offer.

**SANTA FE WATCH COMPANY**
**C.80 Thomas Bldg,, Topeka, Kansas**
(Home of the Great Santa Fe Railway)

**A Letter, Post Card or this Coupon Will Bring My Beautiful Free Watch Book**

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Please send me your new Watch Book with the understanding that this request does not obligate me in any way.

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Complete Professional Outfit

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Thousands of snappy young fellows have made their ARTISTS' MODEL SAXOPHONE pay for itself in spare time earnings! Now at last you can be EVERYBODY'S FAVORITE—you can turn your saxophone playing into pleasure and profit!

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**FREE TRIAL** Sensational offer right now! Big complete outfit on 6 DAYS' FREE TRIAL! Consists of $10 case, self-instruction book, sheet music, reeds, strap, pearl keys, etc. Only $1.00 reserves your Saxophone. Small first payment, balance only $3 a month! Highest quality PROFESSIONAL Saxophone outfit now within your reach. Write for catalog.

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Our marvelous practical **Movie Machines** sell as low as $5.00—and what's more, we have wonderful films at lowest prices—with a new film rental service. **Don't Miss This!**

*Write NOW for Free Catalogue*
**PARAMOUNT MFG. COMPANY**
Box 1371, . . . Dept. P. S.
Boston, Mass., U. S. A.

## Radio Receiving Set Fits Well in Sectional Bookcase

ONE radio fan solved the problem of providing a neat and convenient cabinet for his radio receiving set by putting it in one compartment of his sectional bookcase. A 1-in. thick wooden baseboard was stained ebony black, and the composition panel was attached to the base with short brass screws. The set was shallow enough so that, when placed on

**A convenient place for the radio set. The loud speaker, if used, can be placed on top of the bookcase**

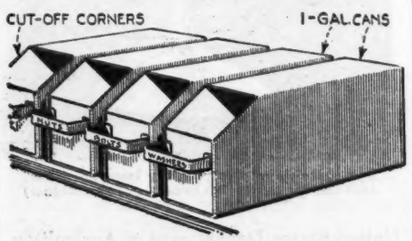
the bookshelf, the sliding door of the compartment could be shut.

Being placed in the third tier, the set is just the right height for comfortable operation. The cavity to the right of the panel is utilized as a storage place for the head phones, and a hook screwed to the end of the bookcase supports wires that run to the batteries. The batteries are placed in a neat box, stained and varnished to match the bookcase.

When adjustments are necessary, the set is pulled out bodily and placed on a table.—J. R.

## Cheaply Made Bins for Nails, Screws, and Hardware

MANY home workshops and garages have not a sufficient number of bins or drawers for small parts, such as bolts and nuts. An economical way of




**Empty oilcans with a corner cut off make handy containers in the home workshop**

making containers for this purpose is to cut a corner off empty one-gallon cans, as illustrated. This is easily done with a can opener and tin snips.

The handle is used as a pull for the bin and also provides a place where a label can be glued. Shelves may be arranged to hold any number of cans.—J. E.

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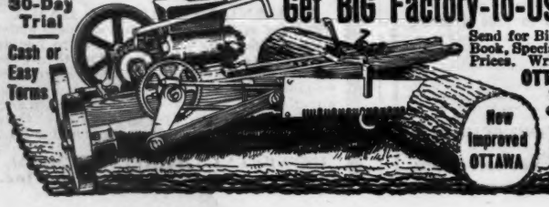


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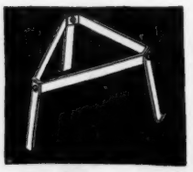
## Camping Out at Home with a Fireplace Cooker

TO THOSE who have an innate desire for campfire cooking, I suggest an occasional meal prepared on a tripod over the flames in the fireplace. Try this for a picnic Sunday supper or for that luxurious night when the maid is away.



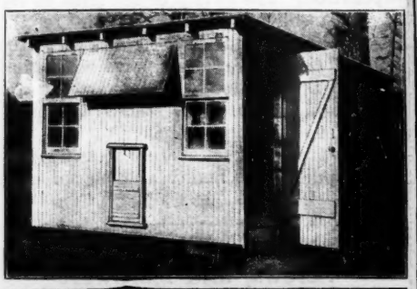
The iron tripod

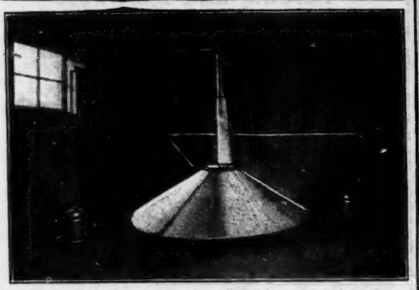
The tripod is necessary because modern fireplaces, although quite common, rarely have cranes. It is simply a triangle of iron with 7- or 8-in. sides mounted on legs that have a slight outward spread for steadiness. The legs may be 4, 5, 6, or more inches high. You can have the stand made by your local blacksmith.

This tripod, which can be placed right over your fire, supports three pans, one on each corner. With a lively blaze to cheer you, you can cook whatever you wish and broil steak over the coals beside.—A. D. P., Hindman, Ky.

## Shed-Roof Brooder House Serves Double Purpose

POULTRY raisers who are planning to build new chicken houses will find a useful suggestion in the accompanying illustration of an up-to-date shed-roof brooder house. It was recently designed and built by the Poultry Husbandry Division of the Bureau of Animal Industry,





The outside of the poultry house (above) and the interior with brooder stove (below)

United States Department of Agriculture, for experimental use at the Government poultry farm, Beltsville, Md.

The house is 10 ft. wide in front and 14 ft. deep. It can be used for laying hens as well as for brooding purposes, so is especially valuable on farms where chicken raising is more or less of a side issue.

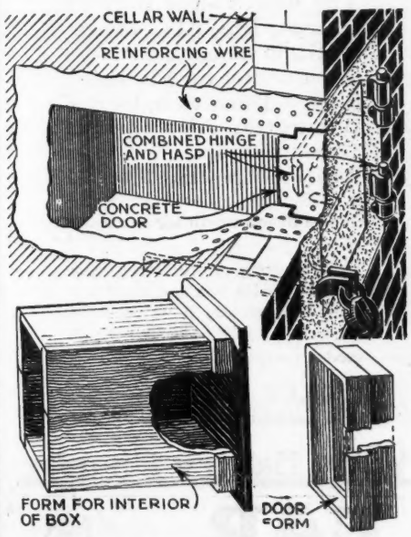
When used as a brooder, the chickens are kept near the stove for the first two days of their life.—S. R. WINTERS.

## Simply Made Concrete Strongbox Safeguards Valuables

By George A. Luers

THE advantage of having a fireproof and, if possible, secret container in the home for deeds, notes, valuable papers, jewelry, and silver plate, can hardly be overestimated. Any one who has been through a fire or suffered a burglary knows the dollars-and-cents value of a good strongbox. The small deposit boxes available at banking places are best of all, of course, but relatively few householders find it convenient to use them for everyday purposes.

To make up a serviceable small safe deposit box of concrete is not difficult and it will be fireproof and, if well concealed,




**Cut-away view of the completed strongbox and the wooden forms**

practically burglar-proof. A basement wall location is usually best. If the box is built into a wall it cannot very well be removed from the building, and if it is concealed with a screen or shelving, it is not likely to be discovered by any outsider.

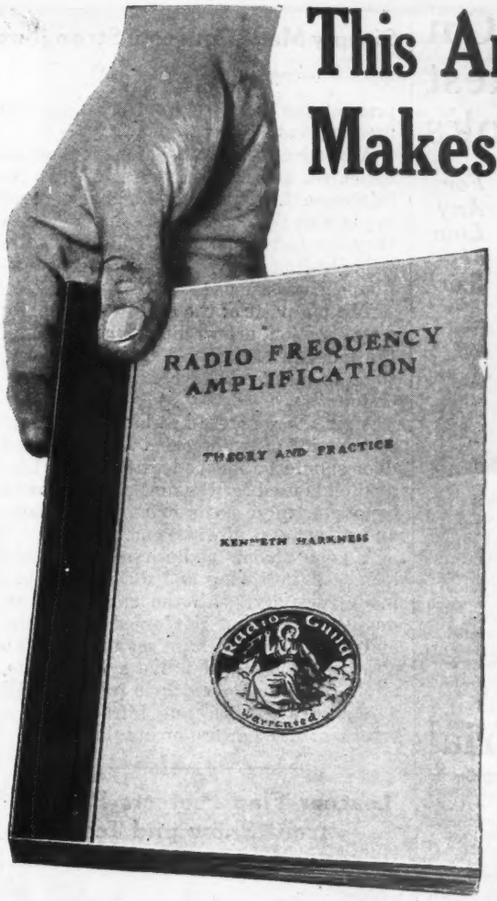
A 2-ft. square excavation, about 3 ft. deep, is made into one of the walls at the desired location. A box form is constructed of wood to form the mold for the interior of the box; this is about 15 in. square and 30 in. deep. The cavity itself serves as the outer mold.

The concrete mixture should be quite rich in cement, the proportions being about one part cement to two parts sand. In pouring the box, the forward top section of the form is left off; the concrete is then poured in and tamped, and the final filling is made at a small aperture above the edge of the top of the form after the top piece is put on.

To do this properly requires some care and the mixture must be quite liquid, in order to prevent any "voids" being left in the concrete. In many cases it is easier to dig down through the earth from outside, if the distance is not great, and fill the back part of the form from above. In fact, various expedients can be adopted in pouring forms of this type. Meshed wire is used about the front of the box to

(*Turn to page 116*)


# This Amazing Book Makes Radio Easy

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## Simply Made Concrete Strongbox

(*Continued from page 115*)

prevent the concrete from cracking and breaking out.

A wooden form is made for the door, as indicated, and meshed wire is used as reinforcement. The hinges and hasp are set in place as the concrete is poured, so that they are cast integrally. These parts are wrought-iron fixtures of heavy construction, such as are used for barn doors.

The pin parts of the hinges, which enter a wall section, are wrapped with wire and the ends are left protruding into the form, so as to make a solid bond into the concrete.

After the concrete has hardened or set for a period of two weeks, the interior and door should be finished with paint. Linseed oil is used for the first coat, followed by one or more coats of any good paint and a final coat of white enamel.

A good strong padlock serves as the lock. If the casing and door have been made carefully, with the concrete thoroughly mixed and reinforced with wire, and the hinges and hasp set to match up evenly, the box will prove a tight, safe, and commodious receptacle for the small valuables that are not infrequently a total loss through fire or burglary.

## Leather Flap Protects Padlock from Snow and Ice

ALTHOUGH the better grades of padlocks are designed to withstand exposure and abuse, they will last longer and be easier to handle if protected with leather or rubber flaps, as shown. Even in the most severe weather, these protectors prevent the padlocks and hasps from becoming frozen and caked with ice and snow.—F. J. A.

## To Clean Household Brushes

BRISTLE brushes should be washed with lukewarm water and a little ammonia, although borax or soda can be used in place of ammonia. Cleanse the bristle part thoroughly, shake out, and let the brush dry in the sunshine.

Dipping the bristles in a strong solution of alum will make them stiffer.—R.C.

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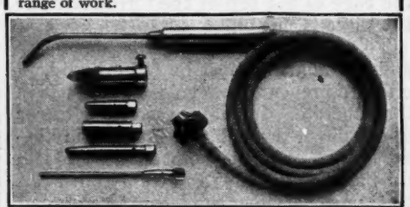

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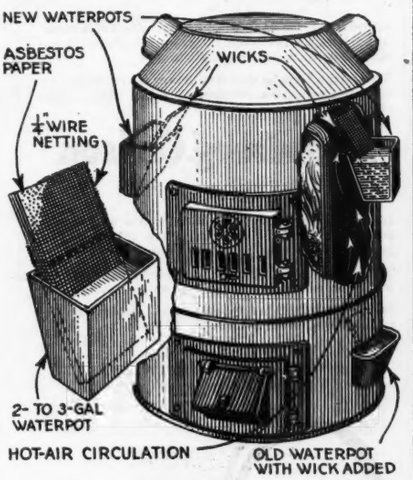
## Adding Humidifiers and Wicks to a Hot-Air Furnace

IF YOUR furnace is of the old-fashioned hot-air type, it probably has only one small waterpot and that in the bottom of the furnace. This is too low to get very warm and therefore does not supply a sufficient amount of moisture to humidify the air properly.

Since dry air at 80 degrees is not as healthy and does not feel as warm as air at 70 degrees, or lower, with the proper amount of moisture, it is important to add additional humidifiers. This can be done without great expense if the furnace man, while overhauling the furnace for the winter, places another waterpot or two close to the top of the furnace jacket. Have him also make asbestos wicks for each waterpot, as shown. If you can do the work yourself, so much the better.

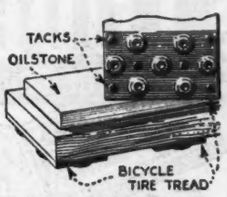



**Two water pans are added high up in the furnace jacket, provided with asbestos wicks**

The working of these humidifiers is obvious. The cold air is heated and in passing up is deflected around the wicks, absorbing from them a considerable amount of moisture. Care will have to be taken to fill the waterpots at least once a day, as in actual operation it was found that these wicks suck up and throw off at least 2 or 3 gallons of water a day.—JOHN H. WACK, Toledo, Ohio.

## Bicycle Tire Tread Prevents Oilstone from Slipping

TO PREVENT my oilstone from slipping on the bench while I am sharpening plane irons and chisels, I have tacked to the bottom of the case strips cut from an old bicycle tire. Rubber from an old auto shoe, a number of small rubber head nails or screws, or almost any form of rubber will serve the same purpose and make it unnecessary to hold the stone in the vise, thus saving time.—HAROLD A. GUSTAFSON, Chicago, Ill.

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L 17—[illegible] betrothal ring, solid platinum; fine diamond in center, 4 diamonds on sides. $120.00.

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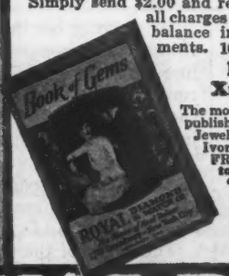


L 1—Fine diamond [illegible] 18 K. white gold top, 14 K. green gold shank. $30.00.

L [illegible]—Genuine [illegible] 14 K. [illegible] mond, [illegible] white gold top. $48.50.

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CULTIVATE YOUR MUSICAL BUMP


## Butterfly Wing Table Makes Charming Christmas Gift

**By Stanley W. Blanchard**

THIS little table is a beautiful piece for any hall or odd corner, especially if placed underneath an antique mirror, with candles at either end, and a vase of flowers or an old-fashioned tray with a candle snuffer in the center. It has such charm and individuality that it will pay, many times over, for the trouble of making. It is especially suitable for a Christmas gift.

A little lower than the average table, it will be found useful beside the comfortable chairs of the living-room for tea or games. The table, when folded, occupies a space only 12 by 30 in.

Any good wood will look well in this table, but as its lines are Colonial, a dull or hand rubbed mahogany is, to my mind, best suited. Any of the methods of finishing antique furniture described in the May, 1923, issue of POPULAR SCIENCE MONTHLY may be used with excellent results.

**This ornamental table measures only 12 by 30 in. when it is folded**

The mortise and tenon construction is well within the ability of the average home worker. The only screws used are those holding on the table-top and hinges.

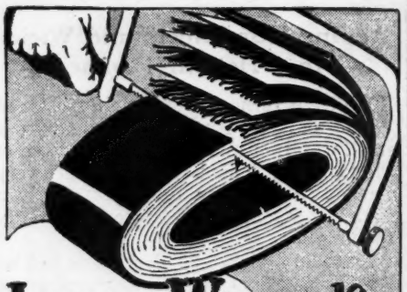
The most difficult part, in my estimation, is the making of the rule joint forming the hinge between the leaves and the top. This can be made quickly with a combination molding plane, if available. Any one who never before has made this kind of a joint will do well to make an experimental joint first on the edges of two waste boards, and actually mount the hinges.

In putting on the hinges, the one big thing to be observed is to have the center line of the hinge coincide exactly with the center line of the quarter-round part of the molding. If this is done and the joint is planed true, it will work smoothly.

It is not absolutely necessary to use this joint. The edges may be left square and hung by hinges in the usual way, but the rule joint adds a craftsmanlike finish.

The edges of the top of the table and of the wings should be well rounded. The wooden pivot on the bottom of each wing, as well as the top metal pivot, should be lubricated with graphite before being put in place.

(*Continued on page 119*)

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**This high grade construction is revealed by sawing through a section of a coil taken from the—**

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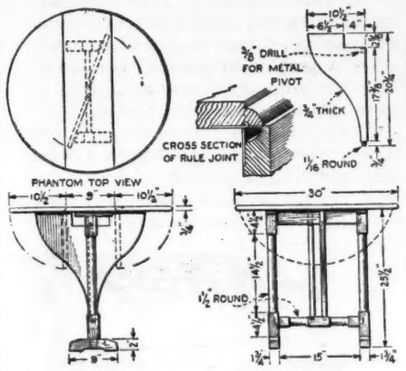
RELIEVE YOUR TROUBLE ZONE
*– the nose and throat*
WITH LUDEN'S

5¢

## Small Butterfly Wing Table

(*Continued from page 118*)

The holes in the top stretcher for the metal pivots are bored slightly deeper than the length of the pins to aid in assembling or removing the wings if it is ever necessary to do so. By turning the table upside down the metal pins of the wings will fall to the bottom of the holes,

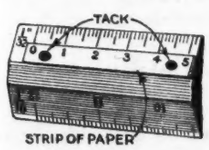



**Top, end, and side views of the table and details of the wings and rule joints**

thus partly freeing the wings, which may be drawn to one side to clear the top stretcher. Then the wing can be drawn from the bottom socket. If the holes in the wings for the metal pins are countersunk, as for a screw head, it will aid materially in replacing the pins when the table is right side up.

## Time-Saving Scale for Making Half-Size Drawings

NOT infrequently a home worker or mechanic finds it necessary to make a half-size drawing when he has not a special scale graduated for that purpose. An ordinary scale graduated in sixteenths and thirty-seconds can be converted into a special scale by gluing or tacking to it a strip of heavy white paper, on which the figure 1 is marked at a point matching up with the ½-in. graduation; figure 2 at the 1-in. graduation, and so on.

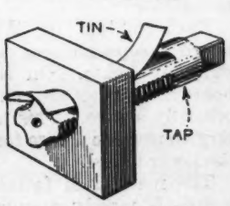



**How the paper strip is marked**

The time taken to convert the scale will be more than made up in the actual drafting, as it eliminates mental divisions otherwise necessary and lessens the chance of error.—C. M. W.

## Tapping a Hole Oversize

RECENTLY I found it necessary to tap a hole out to 25/32 in. and not having a tap this size, I first tapped the hole with a ¾-16 thread tap. Then I placed a piece of 1/32-in. soft tin on the top edge and ran the tap in again. This did the work well.—R. T.




**A useful "kink" for rough work**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**Tuska Popular No. 225**

3-bulb Regenerative Receiving Set. Piano finish mahogany cabinet. Amplifier switch. Concealed binding posts. Armstrong circuit, licensed under Patent No. 1,113,149. Price $75, without bulbs, batteries or loud speaker.

Ask for special circular No. 19-D, describing this set.

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Tuska owners are not obliged to tinker incessantly and add devices to correct construction faults. Their pleasure is unmarred by troubles. Every Tuska set is finished with exacting care by painstaking New England workmen—the best that live. Then it is examined and tested on distant signals by inspectors who are keenly critical. Both manufacturing and testing are under the personal direction of C. D. Tuska, a pioneer radio engineer.

For a dozen years before general radio broadcasting began, Tuska-made instruments were famous among radio experimenters for skillful design, superb workmanship and high efficiency. In the past two years, the demand for Tuska Radio has grown enormously. Each set in this increased production of to-day is as perfectly built as the finest Tuska instrument ever made—and yet, the prices are remarkably moderate for high-grade radio receivers.

***Ask any first-class radio store to show you one of the models of Tuska Radio, priced $35 upward.***

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**Ogden, Utah, receives Troy, N. Y.**

"In one evening, using Tuska 225 with one amplifier only, I received 19 stations, including San Francisco; Calgary, Alberta; and Troy, N. Y. Conditions were not abnormal, and the same stations were received again last night.

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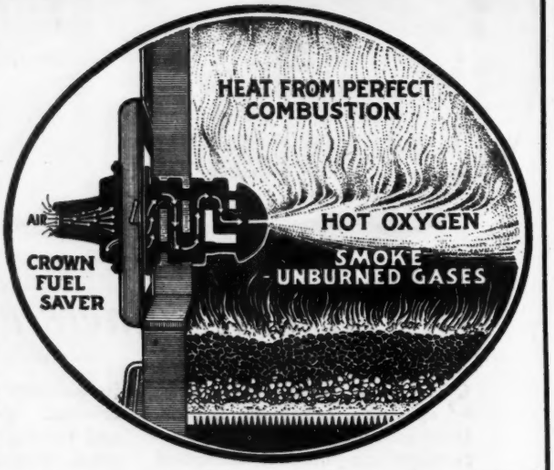


Equip your heating plant with a CROWN FUEL SAVER and learn what winter comfort means. Over 10,000 satisfied users of the CROWN are getting more heat, steadier heat and cleaner heat. They are cutting down their coal bills 1/5 to 1/2; eliminating smoke and deadly gases; and reducing the number of times they must fire the furnace.

**The CROWN** does its work without any care or attention. Never gets out of order. The CROWN fits the feed door of any heating plant (see illustration) and provides, by means of natural draft, the hot oxygen (air) necessary to burn the rich gases that rise from the fuel bed. These gases are ordinarily wasted going up the chimney as "smoke." The CROWN turns this waste into **intense** heat and assures almost perfect combustion. The CROWN may be easily installed without putting out your furnace fire.

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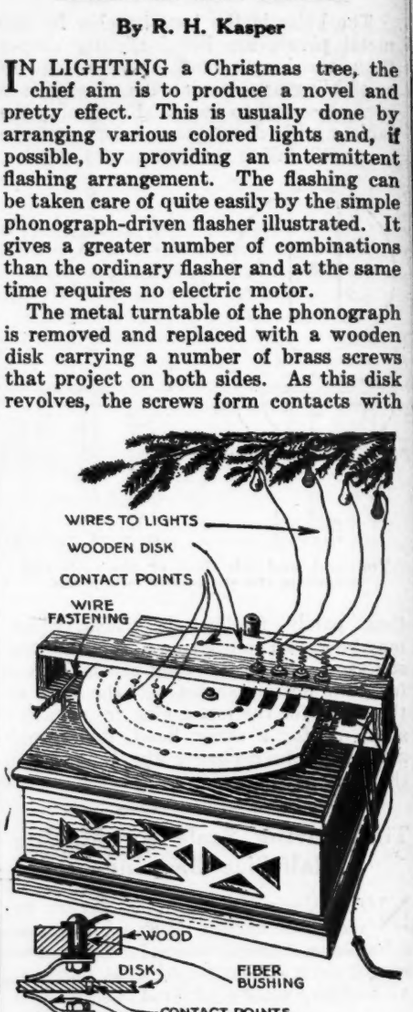
## Phonograph Operates Novel Christmas Tree Flasher

**By R. H. Kasper**

IN LIGHTING a Christmas tree, the chief aim is to produce a novel and pretty effect. This is usually done by arranging various colored lights and, if possible, by providing an intermittent flashing arrangement. The flashing can be taken care of quite easily by the simple phonograph-driven flasher illustrated. It gives a greater number of combinations than the ordinary flasher and at the same time requires no electric motor.

The metal turntable of the phonograph is removed and replaced with a wooden disk carrying a number of brass screws that project on both sides. As this disk revolves, the screws form contacts with




**With only four strings of lights, this ingenious flasher gives 15 different combinations**

brass springs arranged on both sides in a holder, as shown.

The number of brass springs or contacts carried on the upper and lower boards of the holder depends on the number of lights used. One contact is required for each string of lights. Four strings will be sufficient for the average home tree.

It will be seen that each screw that passes through the spring holders is insulated by two fiber washers and a fiber or rubber bushing. This may not be absolutely necessary but is done as a matter of precaution.

Each contact on the upper contact board is separate and carries a wire to a string of lights. On the lower contact board the screws are connected with each other by a wire. This makes it unnecessary to provide a wire for each contact on the lower board.

The method of fastening the contact boards is merely a suggestion, as much depends on the type of talking machine used. As it would not be desirable to screw them in place, they may be held in

(*Continued on page 121*)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FERRY & CO., 75 W. Van Buren St., Dept. 1784 Chicago, Ill.

## Phonograph Operates Flasher

(*Continued from page 120*)

position by weights, by placing them inside the cabinet and using soft wedges, or in any way that suggests itself.

When a screw on the disk passes between an upper and lower spring contact, the electrical circuit is completed and the lights light until the screw runs off the contacts.

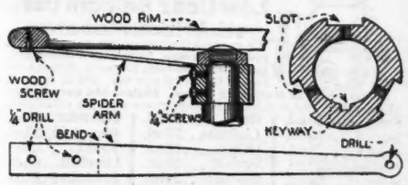
The method of laying out the wooden disk is made clear in the illustration. There are four circles, one for each contact. The number of divisions of the plate depends on the number of color combinations desired, the limit being set by the number of strings of lights employed. With four strings it is possible to produce 15 different combinations. This is done by using each string separately, and then two or more strings in combination.

The screws are set in the disk in the same manner as in the spring holders except that there are no connections, the screws serving merely to connect the upper and lower spring contacts between which it passes. The speed of the disk is reduced as far as possible with the adjustment provided on the machine and the friction of the contact reduces it to a still greater degree.

The method of arranging the lights is optional. All the lights on one string may be of the same color, or they may be different. Experiment will determine which gives the most pleasing effect in the decoration of any given tree.

## Making an Auto Steering Wheel Spider and Hub

IF A larger steering wheel is to be fitted to an automobile, or a wheel has to be made for a homemade motor vehicle, the construction of the spider and hub can be easily accomplished. Secure a wooden rim of the diameter desired and then turn up a piece of cold-rolled steel shafting to the proper diameter to form the hub.




**How the hub and arms are made and put together to hold the wooden wheel**

Slot it in three places, as shown, the slots being just deep enough to give the spider arms a solid anchorage. The hub should have a keyway to fasten the wheel to the steering column.

The arms proper are made of flat steel stock, neatly tapered off. Three arms, if strong enough, are sufficient, although four lighter ones also make a good looking job. A hole for a wood screw is drilled and countersunk in the eye end of each; the other end is drilled for ¼-in. oval countersunk head screws. The arms are then bent to the required angle.

The corners of the arms should be neatly beveled off and the metal painted with black enamel.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# To Sales Managers, and other executives or employers of men

**A sure-fire Christmas remembrance for the "go-getters"**

The man-to-man gift should be something of a friendly, masculine sort—and something that doesn't presume too much upon personal tastes. Men don't like to be sentenced to wear neckties, scarf-pins, or other adornments of another's choosing.

As the ladies have not, as yet, taken up pipe-smoking, pipe-tobacco remains "he-stuff." Nothing up-stage about it, either; since the first Indian pipe-of-peace, tobacco has been a symbol of democracy and the brotherhood of man.

No harm is done if some lucky fellow gets two or three jars of tobacco from different friends. Duplicates are welcomed. The more, the merrier Christmas.

Edgeworth is so generally liked that it's a safe, sure-fire present for men. In the glass humidor jar it keeps in condition indefinitely.

These 16-ounce jars are sold at $1.65 at all tobacco stores; but if your regular dealer hasn't enough of them, we offer you this painless plan, just to relieve the pressure on Santa Claus:

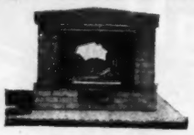
Send us $1.65 for each pound jar of Edgeworth to be sent out, a list of the names and addresses of those you wish to remember, together with your personal greeting cards.

We will pack each jar in an appropriate Christmas box, enclose your card, and send them all off in plenty of time to be delivered before December 25th.

**Personal**—If you are not personally acquainted with Edgeworth, we will be glad to send you free samples—generous helpings both of Edgeworth Plug Slice and Ready Rubbed.

Kindly address Larus & Brother Company, 59 South 21st Street, Richmond, Va. If you will also include on your postcard the name and address of your regular tobacco dealer, your courtesy will be appreciated.

*To Retail Tobacco Merchants:* If your jobber cannot supply you with Edgeworth, Larus & Brother Company will gladly send you prepaid by parcel post a one- or two-dozen carton of any size of Edgeworth Plug Slice or Ready Rubbed for the same price you would pay the jobber.

## Building a Realistic Toy Theater

**By Ernest Bade, Ph.D.**

IT IS Christmas and the room is dark. A square of light is seen through the door; this reveals a miniature stage. Slowly the curtain rises. A tropical shore is seen in the white light of the Southern sun. The sky assumes the fiery hues of a tropical sunset. The sun sinks below the horizon, while a rosy light ripples upon the quiet ocean swell. The waves move! Slowly the scene grows darker, and the curtain falls.

Such is a scene that can be played upon this tiny stage. A number of settings arranged with tiny cardboard figures will illustrate any play or story, such as "Robinson Crusoe" or "The Sleeping Beauty."

First obtain or make a box approximately 5 in. high, 12 in. long, and 14 in.

**Setting up the two stage frames, which rest in sockets in the box**

wide. The lid is hinged at the top of one of the wide and long sides, but before the hinges are attached, make two light squares, each open on one side, as shown. Use thin strips of wood for them. The larger one is made so that it just fits within the box, while the smaller is about 4 in. shorter but just as wide.

Next cut two slits in the front of the box so that the tall U-shaped wooden frame fits snugly, and place a little bracket on the bottom of the box so that the frame will be held firmly. Do the same at the back of the box for the shorter U.

Three parallel grooves are then cut into the top of the box cover. These are ¼-in. wide and are placed at equal distances from each other. The first is placed about 1 in. from the back of the box, the second two thirds of the way from the front and the last one third of the distance from the front. Now fasten the hinges to the box and place the legs of the two U-shaped pieces in their holes, the larger one being, of course, in front.

Cut two strips of wood so that they just fit between the two frames, and also groove these to correspond with the grooves on the stage. These two braces or bars are then provided with sheet-tin hooks taken from a tin box. Eyes to fit these hooks are fastened to the top of the uprights. This completes the woodwork.

For the proscenium use a strong, stiff piece of cardboard or wallboard. Carefully paste some wallpaper, pictures, or

(Continued on page 123)

**The New Gibson Tenor Banjo is featured in Bob Miller's Steamer Idlewild Orchestra**

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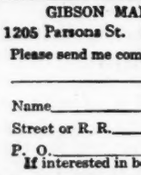

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| Buick 6 | 24 mi. | Olds. 6 | 23 mi. | Nash 6 | 23 mi. |
| Hudson | 20 mi. | Paige 6 | 20 mi. | Lincoln 8 | 17 mi. |
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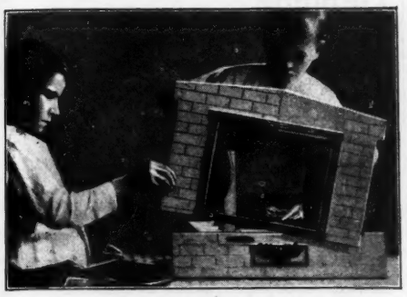
## Building a Realistic Toy Theater

(*Continued from page 122*)

designs from magazines, and a few colored papers together to make some kind of an ornamental arrangement around this frame, leaving a clear stage opening 8 in. wide and 7 in. high, which is later cut out. It is well to use two pieces of cardboard for the arch, joining them together with a strip of calico pasted on the back.



**The proscenium is made from cardboard and covered with wallpaper and colored cutouts**

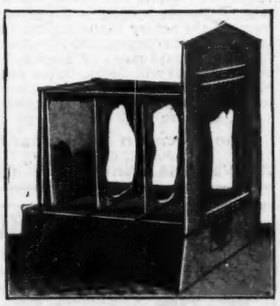
This will permit folding so that the proscenium can be packed away in the box when the stage is to be put away.

The front of the box is concealed by another cardboard strip 5 in. high and about 20 in. long. This is also in two parts so that it will fit into the box.

The curtain is just back of the proscenium and consists of a piece of cloth with a picture pasted on it. It is weighted on the bottom with one or two pieces of iron wire. Near one end a cord is firmly fastened for raising or lowering the curtain, the cord winding around the roller. The roller is held in place like any window-curtain shade.

The side scenes and backgrounds can now be made. Each background must have two side scenes to match, cut from cardboard about 11 in. long and 9 in. high. The opening in each side scene may be the same as the stage opening, that is, 7 by 8 in., although it is better to make it about 1 in. larger each way.

The backgrounds also are 9 by 11 in. They may consist of some simple scene cut from magazines or books, showing rural landscapes, interiors, street scenes, harbors, and the like. The background must fit in the last groove of the stage and of the upper bars; the side scenes fit the other grooves, so that all can be pushed in and pulled out easily.

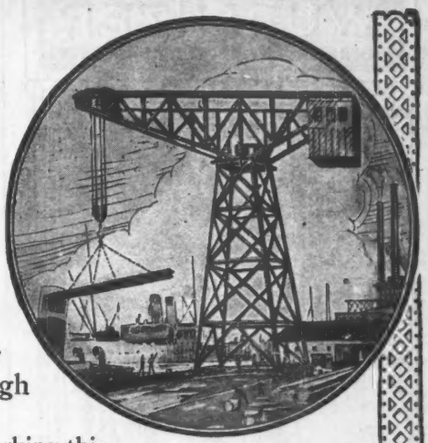


**The complete stage, showing the sliding background and side scenes**

When a number of scenes have been prepared, a few figures can be mounted on cardboard and cut out. Placed on the stage in small wire brackets, small plays

(*Turn to page 124*)


# Wouldn't you like to work this 10 ton CRANE?



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## Building a Realistic Toy Theater

(*Continued from page 123*)

can be performed with these figures.

Almost all the backgrounds can be made transparent and quite a number of them can be made movable. A rising moon can be made by cutting a 1-in. strip out of the cardboard sky from the horizon to the top of the picture. Take a piece of black paper about 1 ft. in length and cut it 1 in. wide. In the center cut a small round hole to represent the moon. Paste two strips of cardboard along the cutout in the background, to form a groove for the black paper. Light the back of the stage with a lamp or a flashlight and gently pull the strip of black paper upward. This will give the effect of the rising moon.

Other effects to be obtained are the lighting up of windows, lightning flashes, twinkling stars, moving waters reflecting the rising moon or setting sun, rainbows, and the like. Elaborate cutouts can be glued to netting, which can be used to aid in many novel stage effects. To increase the effect, small toy electric lights may be added. These can be worked either through a transformer or by a set of batteries.

There should be at least two footlights —a blue light and a white light—and two droplights, the first being placed just in front of the first scene and the second in front of the second side scene. By using a dimmer or rheostat connected with the white lights, the lighting can be lowered gradually until the one blue light left burning gives the effect of night. These lighting devices greatly increase the charm of the model theater, especially if the backgrounds have been made transparent.

## Yardstick Set in Bench Serves for Rough Measurements

REPEATED handling of a rule at the woodworking bench can be avoided to some extent by inlaying a yardstick in the top of the bench near the front edge.

When the carpenter who devised this method wishes to measure a few feet of

Measuring a length of molding with a ruler inlaid in the bench top

stock, particularly of the molding and lighter materials which he mostly handles, he simply runs it close against his bench parallel with the ruler and marks off the length.—FRANK V. FAULHABER, Brooklyn, N. Y.

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## Fairy Figures Form Novel Christmas-Tree Stand

CHRISTMAS trees in Europe, where so many of our Yuletide customs originated, are usually gathered and sold with the roots attached. They are then set up in a large pot or tub, according to size. This has advantages, from a picturesque standpoint, over the American practice of mounting Christmas trees on a stand of two crossed sticks.

More novel than either method is to have some pixies or fairies holding the tree upright. Three or four of these, as shown in the accompanying illustration, can be cut from thin wood (three-ply paneling is best) with a fretsaw or a sharp knife and painted as decoratively as possible. These figures do not require a solid base; a diagonal brace between them will be ample. Flat pieces may be nailed to their backs, if desired, to make it easier to attach them to the tree trunk.

**Cut from plywood and gaily painted, these figures make an attractive support for the Yule Tree**

Another method is to make the figures like big dolls, but with stiff wire along the legs and up the backs, passing out through the shoulders and round the stem of the tree, with perhaps a sash right around them all for a lower support.

Make the figures large enough to form a steady support, say 18 in. high for a 6-ft. tree.—E. A. M.

## FEATURES FOR JANUARY

NO MATTER what particular aspect of the home workshop interests you most, you will find exceptionally useful articles relating to it in next month's POPULAR SCIENCE MONTHLY.

First there are the prize-winning letters in the recent tool contest.

Then, for the woodworker, there are articles on how to build an ideal home workshop wall cabinet for tools and a combination bench hook, miter block, and shooting board; on weatherstripping your home, and on rebuilding a pedestal dining table.

Those interested in outdoor sports will find unusually good plans for a non-tipping bobsled and a racing skate sail.

For the children, there is a child's kitchen cabinet; for the typist, a cheap method for making rubber keys. Similarly, for the autoist, the radio fan, and the metal worker, there is a great wealth of helpful material.


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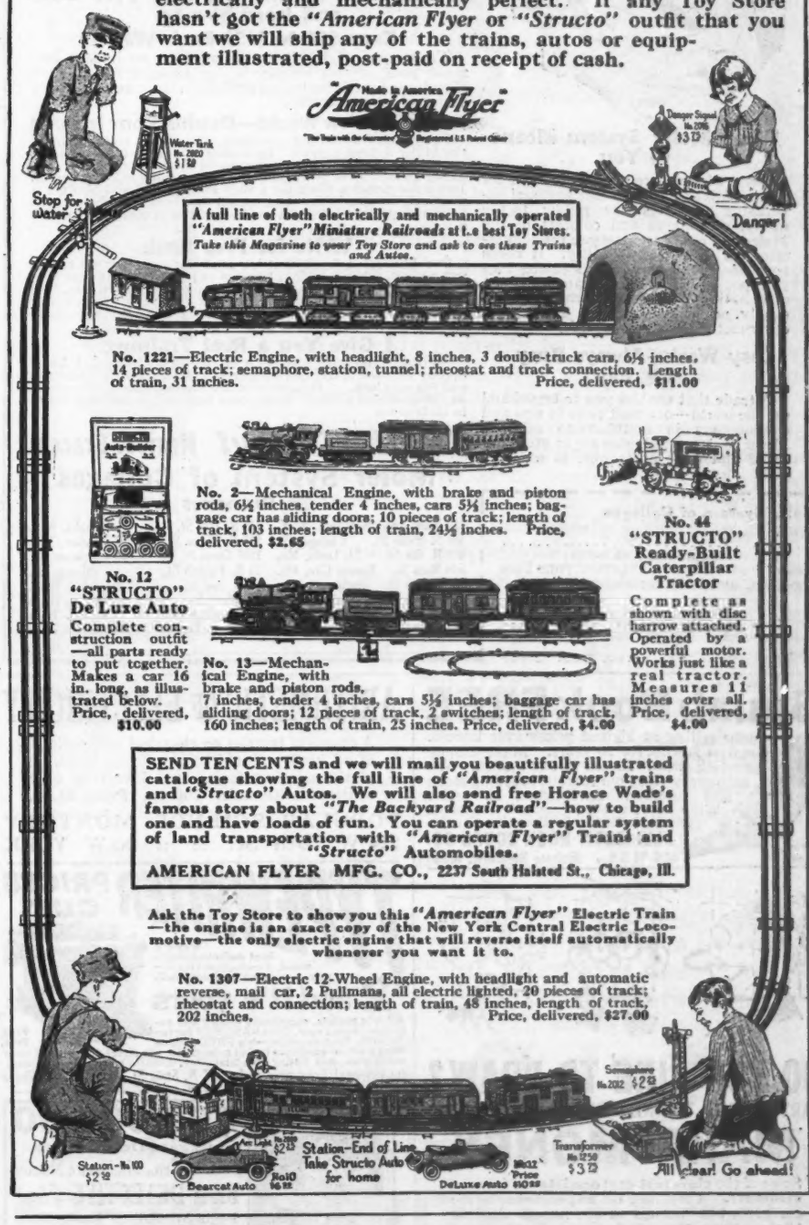
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## A Radio Set for Christmas

(*Continued from page 80*)

points of contact with the binding posts, is then used to join the contacts numbered 1 of rheostats *D* and *Q* with binding post $U_1$. The No. 2 contact post of rheostat *D* is then connected with the remaining *F* terminal of socket *H*, while another wire is used to connect the remaining *F* terminals of sockets *N* and *T* with contact post No. 2 of rheostat *Q*. By means of these connections, rheostat *D* is used to control the filament current of the detector tube in socket *H*, while rheostat *Q* controls the filament current of both amplifier tubes.

Now connect the *P* terminal of transformer *I* with the inside jack spring of jack *J*, which makes contact with the outside spring, to which one of the leads from rotor winding *L* is connected. The other inside terminal of the jack is connected with the *B* terminal of transformer *I* and the remaining outside terminal is connected with binding post $U_3$.

The *F* terminal of transformer *I* is connected with binding post $U_4$, and the *G* terminal of the transformer with terminal *G* of socket *N*.

### *How to Wire the Jacks*

The *P* terminal of socket *N* is connected with the top outside spring of jack *P* and the inside spring of the jack, which makes contact with this spring, is connected with the *P* terminal of transformer *O*. Binding post $U_5$ is connected with the bottom outside spring of the jack, while the inside spring, which makes contact with it, is connected with the *B* terminal of transformer *O*.

The *G* terminal of transformer *O* is then connected with the *G* terminal of socket *T*, and the *F* terminal of the same transformer is connected with binding post $U_6$. The wiring of the set is completed by connecting the top spring of jack *S* with the *P* terminal of socket *T* and the bottom spring of the jack should be connected with binding post $U_7$.

The type of A battery employed will naturally vary with the type of tubes that are used. Best results will be obtained when a soft six-volt tube of the UV-200 or C-300 type is used as a detector and hard tubes of the C-301-A or UV-201-A types are used as amplifiers. If a soft tube is used as a detector, rheostat *D* should be of the Vernier type. In this particular set, however, dry cell tubes of the UV-199 or C-299 type are used throughout and give excellent results, both for distance and strength of signals.

The minus or negative terminal of the A battery is connected with $U_1$. The positive of the A, the negative of the B, and the positive of the C batteries are connected with binding post $U_8$. If a soft tube is used as a detector, the 22½-volt terminal of the B battery is connected with binding post $U_3$, while if one of the hard tubes is used as a detector tube, the 45-volt terminal of the B battery should be connected with that binding post.

The leads from binding posts $U_4$ and $U_6$ are tried on various terminals of the C battery until the best value of the grid

(*Continued on page 127*)

## A Radio Set for Christmas

(*Continued from page 126*)

bias on the grids of the amplifier tubes is obtained.

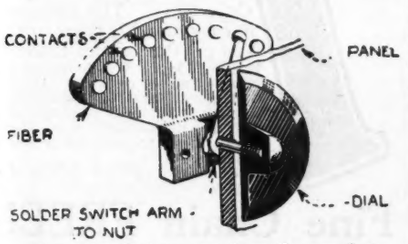
Binding posts $U_5$ and $U_7$ are tried on various terminals of the B battery varying from 45 to 90 volts.

The operation of the set is very simple. The adjustment of the wave length of the primary circuit is obtained by adjusting the tap switch *E* and the condenser *C*. The wave length of the secondary is adjusted by means of the condenser *T*. The variation of coupling between the secondary and the primary circuits is obtained by turning the rotor *M*, while regeneration is controlled by turning the rotor *L*.

## Radio Inductance Switch Has Hidden Contact Points

THE radio inductance switch illustrated has all contact points at the back of the panel.

The form on which the switch points are mounted is cut from fiber, or seasoned wood coated with hot paraffin. Its




**This switch is mounted on the panel so that no screws or switchpoints are visible**

dimensions depend upon the number of contact points.

Two holes are drilled for the machine screws that hold the switch clamped to the back of the panel and a recess is also cut to make room for the nut that fastens the switch in place. The arm is sweated to the nut and shaft to make the operation thoroughly certain.

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The hanger proper consists of a piece of hardwood about ¼ in. thick, 1 in. wide, and 10 in. long with a hole bored in one end. The hanger is attached by means of a loose-fitting roundhead screw to the wooden strip that supports the closet shelf or to the edge of the shelf itself—anywhere it will go. The other end of the strip is fastened under a screw hook.


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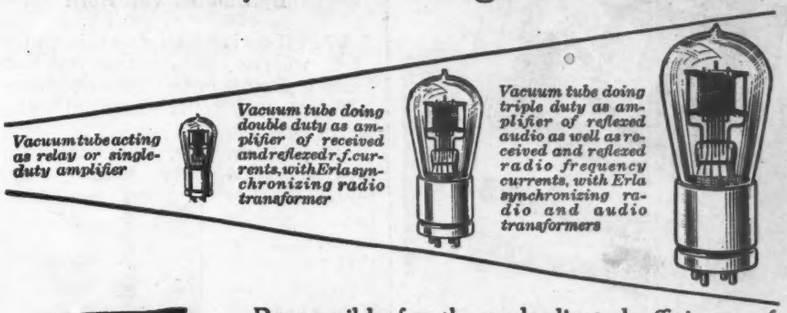
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## Heating Plant Repairs that Will Save You Coal

By Dale R. Van Horn

WITH coal at top prices this winter, it will pay you to see that your house-heating plant is in first class condition.

To get every dollar's worth of heat out of the coal, the heating system must be in good repair. It has been proved time and again that uncovered pipes, or pipes from which the insulating material has been broken, sometimes result in a fuel bill 20 or 25 per cent higher than otherwise would be necessary.

Fig. 1. Mixing asbestos cement with water for covering pipes

Burned-out flues and disintegrating chimneys are a fire hazard, yet the flue pipes are often allowed to rust or corrode clear through in spots before they are replaced. Broken grates, besides preventing perfect combustion, often allow small unburned chunks of coal to drop into the ashpit, adding to the fuel cost. These are only a few of the urgent reasons why the heating plant should be thoroughly inspected each year.

Fig. 2. A cone of tin is used in spreading the cement evenly over exposed pipes

The purpose of pipe covering is to prevent heat losses as much as possible before the heat reaches the radiators or the hot-air registers. The common practice is to cover hot-air pipes with sheet asbestos or cloth covered with an asbestos preparation, and hot water and steam pipes with either honeycomb material, especially prepared for the purpose, or an insulating composition. It is well to remember, however, that dead air spaces are the best insulators of relatively low temperatures, and solid insulation is best for pipe at relatively high temperatures.

Hot-air flues ought, therefore, to be

(*Continued on page 129*)


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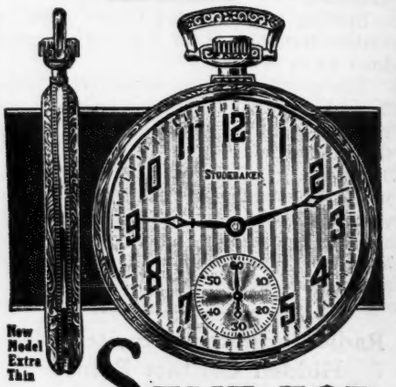


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## Heating Plant Repairs

(*Continued from page 128*)

covered with corrugated insulating material or asbestos at least ¼ in. thick. They can, nevertheless, be insulated to a considerable degree with muslin cut to the proper width, the edges sewn together, and then covered with asbestos cement. The cement is mixed with enough water so that it can be applied with a brush. Two or three coats should be given. A still simpler and less costly process is to paste asbestos paper sheets over the pipes.

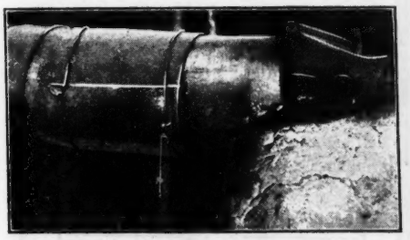

**Fig. 3. This tin-patched smoke pipe illustrates a makeshift repair that is wasteful and hazardous**

Steam or hot-water pipes can be covered with asbestos cement with little difficulty. The cement is mixed (Fig. 1) to a sloppy consistency. A square of tin, free from rust, such as from a tomato can, is then wrapped about the pipe in the form of a cone (Fig. 2) with the largest opening upward (or, if the pipe lies horizontally, forward). With one hand the cement is forced into this, and with the other the tin is slowly moved along. The covering comes out of the small end in a compact, smooth mass. While it will not stand rough usage, the cement will remain indefinitely if left alone. Such a covering, even for large pipes, will not cost more than one or two cents a foot for material. By wrapping cloth about the insulation immediately after it is applied and pressing the fabric into the cement, a more durable surface will be obtained.

An easier method is to buy honeycomb insulation in sections. These are attached by strips of cloth or tin collars. Even the most expensive covering, when applied by high-priced labor, is an economy because of the coal it will save.

Covered pipes also prevent possible radiator repair bills. Last winter an improper installation cost the writer $25. The pipes leading to a north bedroom radiator were of small diameter and uncovered. The total distance from the boiler was 34 ft. During a cold snap this radiator froze and burst five sections because of the excessive cooling of the water before it reached the radiator. The pipes should have been at least 1½ in. in diameter and covered.

**Fig. 4. Patching worn boiler insulation with cement**

(*Turn to page 130*)

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## Heating Plant Repairs

(*Continued from page 129*)

If any part of the sheet-metal smoke pipe to the chimney is rusted through, that section should be replaced. If there is any danger of other portions breaking away within a year or two, the whole section should be replaced. Never, under any circumstances, should one be satisfied with a makeshift repair like that shown in Fig. 3. Here a piece of tin has been wrapped about the hole and held with wires, but several openings will hamper the draft and there is always the chance of a spark getting outside and causing damage.

The chimney, moreover, should be inspected from top to bottom. Where the mortar has cracked or a brick worked loose, repair it with a hard plaster of Portland cement mixed with lime. If the top

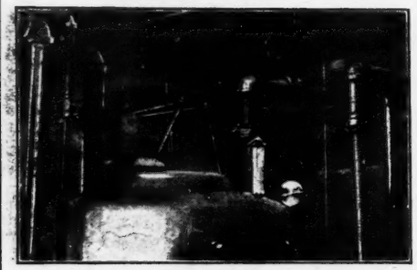

**Fig. 5. Exposed piping like this is a certain indication that coal is being wasted needlessly by the owner of the plant**

of the chimney has begun to disintegrate, remove the loose brick, take the measurements, and build a concrete cap on the ground. The forms are set on a smooth surface, centered, and filled with rich concrete, with reinforcing at the corners. The top should be beveled. After the concrete has thoroughly hardened, hoist the cap to the roof and set in place on the chimney top with mortar.

Clean out all dirt and soot from the furnace. Inspect the grates and, if necessary, replace any worn parts. Go over the covering, patching any places where the asbestos has been worn or broken off (Fig. 4). Asbestos boiler covering, which can be purchased from any plumbing supply house, is quite adhesive when applied to warm surfaces. Always heat the boiler before using it.

If any large surface is to be covered, apply the first coat with a trowel or throw it against the boiler. After the first coat is thoroughly hard, put on a second coat smoothly with a trowel. A good finish can be given by a third coat of one-half Portland cement and one-half asbestos cement, and this can be improved still further with a coat of white lead and oil paint.

Make sure that the gages work properly. Then fill the fuel box with fuel and see if everything goes all right. Specific information regarding any special repairs can be obtained from the dealer from whom the plant was purchased.

A heating plant is often condemned when, as a matter of fact, the owner is at fault because of having attempted to save money by putting in too small pipes or pipes that were not covered. No heating expert is needed to tell that the heating plant partly shown in Fig. 5 is wasteful.


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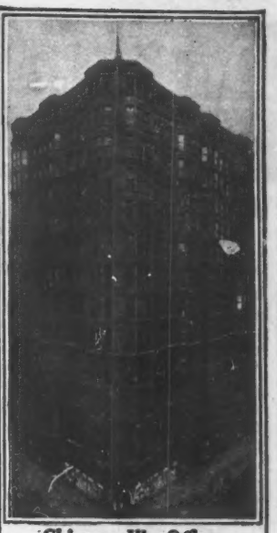

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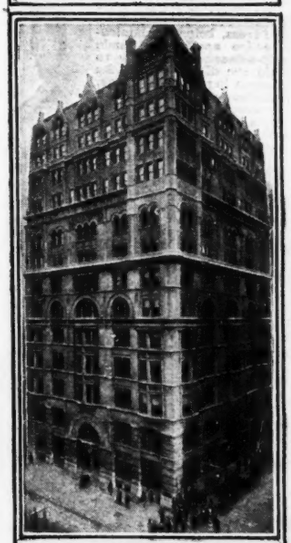

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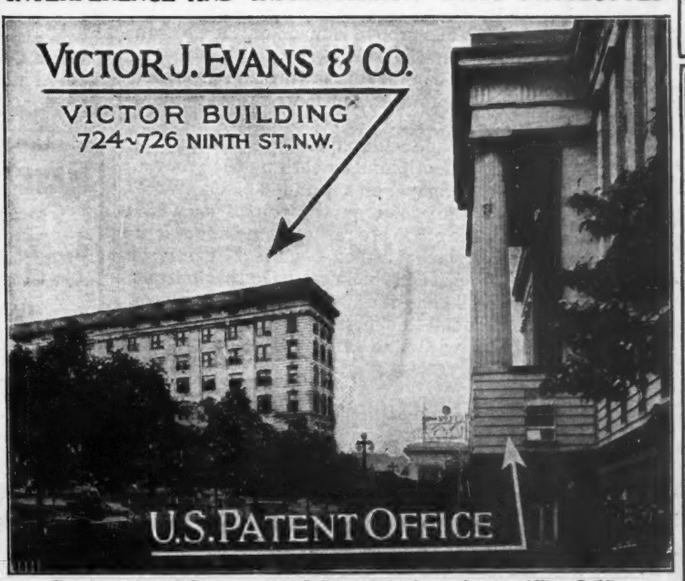


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To Make a Pair of Skis

# Do You Believe in Luck?

Thousands waste the best years of their life waiting for some "stroke of luck" to make them successful. Two men starting exactly alike as babies with the same kind of attention—then as boys with the same advantages of education—then as young men feeling around for a start in life—and then after the final test as men, one is a failure, the other a big success. Is it luck? No indeed.

**At the Age of 2**

He believes in Luck — He in Himself

## Luck vs. Self

The one who succeeded believed in himself. He grabbed his opportunities as he saw them and made good because he was prepared. He planned his progress step by step and fitted himself with special training for the line of work he wanted to follow and liked the best. The other fellow—the failure—blinded by his unreasoning belief in luck that never came, could only say: "That man sure was born lucky."

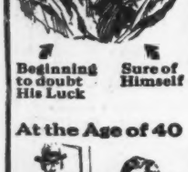
**At the Age of 20**

He still believes in Luck — and He in Himself

## There Is No Luck

Luck is exactly what you make it. There is an old saying—"Those who have—get." The more you go after and get for yourself instead of waiting for "luck" to come, the more good fortune is forced on you. Those who are patiently waiting for something good to turn up are invariably disappointed in life—those who know that they can make their own good fortune always find plenty of it waiting.

**At the Age of 30**



Beginning to doubt His Luck — Sure of Himself

## Stop Idle Dreaming

Take action and make your dreams come true. Make up your mind to be a success in that line of work or profession you like best—get the special training that will fit you. Do this and you will make your own good luck. But remember, the big thing is to be prepared—to have the special training that will enable you to make use of the many opportunities that will surely come your way just as soon as you have unbounded faith in yourself. Now take the first and really most important step in making your own good luck by sending in the coupon. This puts you under no obligation and no agents will bother you.

**At the Age of 40**

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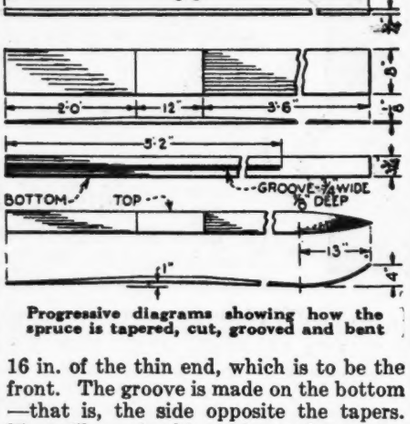
## How to Make a Sportsman's Pair of Skis

By Howard Greene

IF YOU are interested in skiing, which is becoming more popular every winter, you can make quite easily a pair of skis that will look well and give excellent sport. The raw material consists of a spruce board 6 ft. 6 in. long, 8 in. wide, and ¾ in. thick. The length is a good average; a tall man will need a little more and a short man a little less.

Mark two lines across the board, one 2 ft. from one end and the other 3 ft. 6 in. from the other end. Have the mill or a woodworking shop, if possible, saw a taper from these lines to the ends, so that when planed smooth the board will be ⅛ in. thick at the end of the long taper and ¼ in. thick at the end of the short taper.

The board next is ripped down the center. Then a groove is cut down the center of each piece, extending to within




Progressive diagrams showing how the spruce is tapered, cut, grooved and bent

16 in. of the thin end, which is to be the front. The groove is made on the bottom—that is, the side opposite the tapers. The mill can do this sawing and grooving in a few minutes, but it would take hours to do by hand.

Plane and sandpaper the bottoms perfectly smooth, and smooth up the grooves with sandpaper on a rounded block. Work down the wood on the top of each ski until the edges are rather thin—about half the original thickness—while the center is left almost full thickness. Do this in front of and behind the 12-in. part that has been left the full thickness of the original board. Finish with fine sandpaper and cut the points. The skis are then ready for bending.

Make a bending form on a bench or heavy plank, as shown. Soak the wood in very hot water for three or four hours. This may be a problem, but perhaps the bathtub can be used. In that case the full length cannot be immersed at once and it will be necessary to reverse the skis every half hour or so, keeping wet cloths around the exposed wood so that it will not dry. This will prolong the soaking considerably. Steaming is better and quicker, and a small steambox fed with steam from a kettle is so easily made and used that it is worth the trouble.

Clamp the skis on the form with strips of wood extending across both at once. See that the points are supported for their

(*Continued on page 133*)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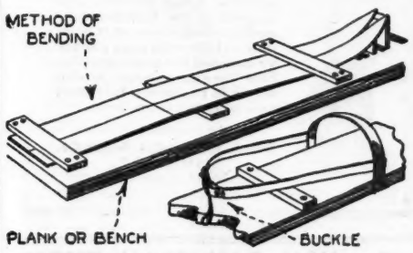
## To Make a Pair of Skis

(*Continued from page 132*)

full width, to avoid splitting while drying. Allowance should be made for the springing back of the wood when removed from the form, say 1 in. extra for the long curve of the body and 1½ in. for the point.

Allow plenty of time for drying; a week is not too much, and damp weather will retard the drying. When dry, give all but the bottom two coats of spar varnish and rub the bottom with hot beeswax, polishing it well with a rag.

There are several types of foot harness, and any kind that strikes the fancy may be copied. The one shown, however,




**The form for bending the skis and one simple design for the foot harness**

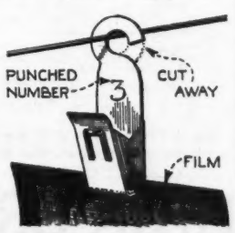
works very well and is easy to make. The toe straps are fastened at the sides with long brass screws with round heads and copper washers under the heads, or they may be passed through slots cut through the wood. The heel straps are riveted to the toe straps with copper rivets.

A pole can be made of either spruce or hard wood; spruce is lighter and strong enough. It may be from 1¼ to 1½ in. in diameter, and of a length to suit the user. A good length is about 5 ft. The usual ring may be made from a large, heavy brass curtain ring, attached to the staff by four leather strips. Wet the leather, pass it around the ring, and rivet it so that it will hug the ring as tightly as possible. Bind the other ends of the strips to the staff with fish-line or the like. When the leather is dry, it will shrink and hold hard on the ring. Then give it a good soaking with neat's-foot oil.

Drive a brass ferrule into the other end of the staff, and put in a long, heavy wood screw to the full depth of the threads. Cut off the head and file the shank to a point.

## Cheap Photo Film Clips

EXCELLENT clips for photo films can be made cheaply from ordinary brass showcard hangers. About half the loop of each hanger is cut out, as shown, with a pair of scissors. These hangers may be used to suspend films in the tank for development, in the fixing bath, in the washing tank, and finally on the line for drying. If desired, the hangers can be numbered with steel stamps, so that the films can be readily identified.—J. A. M.

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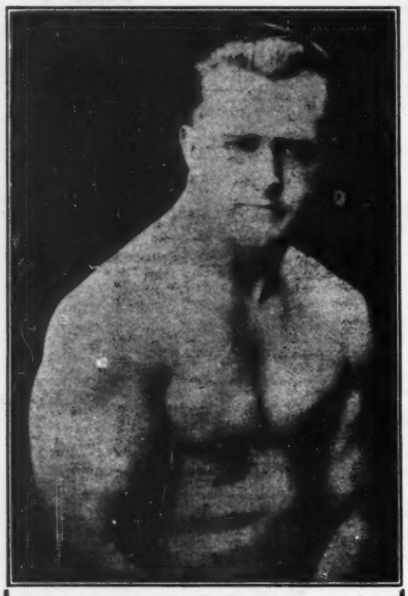

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as he is today

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That's what you need and that's what you get. Come on now, pull in your belt and throw out your chest. Take a good deep breath of that pure air that's all about you. Give your heart a treat with some rich blood. You will feel so good you will think it's your birthday. Drop me a line and I'll show you how to do it. I'm going to put a chest on you that will make your old ribs strain with the pressure. I'm going to change those skinny arms and legs of yours to a real man's size. You will have the strength and vitality to do things you never thought possible. Come on, fellows! Get busy. I don't promise these things—I guarantee them. Are you with me?

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# The Shipshape Home
## *How to Do the Odd Jobs*

### *Files and Filing*

No HOME workbench or tool cabinet is complete without a number of files of different sizes and shapes. For an all-around set of files for the home, I should suggest the following:

10-in. flat wood file
10-in. half-round wood file
10-in. hand file, second cut
10-in. hand file, smooth
6-in. hand file, smooth
8-in. pillar file, second cut
10-in. half-round, second cut
6-in. half-round, second cut
6-in. round, second cut
6-in. handsaw file, double cut, second cut

This set with handles would cost, I estimate, about $7. It goes without saying that it is economy to pick out the best files that can be obtained. A dollar or two more doesn't count in this case, as poor files will not last very long. The files listed will cover almost any job the home

worker will be called on to do, whether repairs, making new articles, or sharpening garden and other tools.

In use a file should always be kept biting; that is, cutting. If the file is allowed to slide half-heartedly over the work, it soon becomes dulled or shiny. On wrought iron or soft steel greater pressure is required to prevent it from glazing or slipping than on cast iron or steel.

To file a narrow surface straight requires considerable practice. When the file begins its stroke, the downward pressure exerted by the left hand holding the outer end should be at its maximum, while a minimum pressure is given by the right hand, which holds the handle. As the file advances, the pressure from the left hand decreases, while that of the other hand increases. After considerable practice, one is able to regulate the pressure on each end of the file unconsciously, so that any "rocking" motion of the file is prevented.

Amateur mechanics sometimes find confusing the various names used in describing files. Terms such as "mill," "flat," and "half-round," refer to the shape or style, that is, the cross section. The cut is referred to by two sets of terms. One refers to the character of the teeth, which may be "single cut," "double cut," or "rasp cut."

(*Continued on page 135*)

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## The Shipshape Home

(*Continued from page 134*)

The other designations are for the degree of coarseness of the teeth—"rough," "coarse," "bastard," "second cut," "smooth," and "dead smooth." The coarse and bastard cuts are used upon rough and heavy work; the second cuts and smooth cuts are used for finer work and for finishing work that has been roughed down by coarser files. The very rough and dead smooth are seldom used.

A file that has one of its edges or sides smooth is called a "safe edge file" and is used in filing in corners where only one side of the corner is being worked.

Files are cutting tools. They should never be thrown into a drawer or be allowed to come in contact with each other or any hardened metal. Keep them in a rack at the back of the bench, each in its own hole, or in a shallow drawer, separated from each other by partitions.

Buy your handles when you buy the files and get good ones. Bore a small hole in each handle to a depth equal to the length of the tang; then counterbore this hole halfway in with a drill or bit of a diameter equal to the thickness of the tang about three quarters up from its point. Drive in the file tang by means of a block of wood held on the file end and struck with a hammer. Never strike a file with anything hard if you value your face.

When buying files and handles, get what is called a "file card," a sort of brush with stiff wire bristles, used for cleaning the files.

Don't allow your files to rust or rub together. Files are the most abused tools in the world and yet among the most useful. You can't get along without files, and they cost money, so take good care of them.—HENRY S. LARABY.

### *Fixing Shade Rollers*

WHEN a window-shade roller refuses to hold, dust some talcum powder on the "live" end roller, as shown, and work it under and around the latches. Talcum powder or ordinary toilet powder is made from soapstone and is a dry lubricant. It is advisable not to use oil, which will collect dust and in time make matters worse.—E. W. CORNELL, Adrian, Mich.

### *Removing Varnish*

IN REMOVING old varnish from floors and other woodwork with varnish remover, the work may be speeded up and lightened by using an ordinary squeegee, such as is used by window washers, instead of steel wool or a scraper. If the varnish remover is applied generously, almost all of the old varnish may be removed in this way by going over the floor once. The squeegee is used as in cleaning a window.


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## The 10 Greatest Inventors

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**GENERAL AGENTS** It is easy to appoint sub agents for this line. We pay you 20% each commission on all orders we receive from local agents appointed by you anywhere. We allow you 50% discount on your own orders. You can sell to nearby trade or travel all over the country as you please. Large demand for window lettering everywhere. Write today for free sample, full particulars and liberal offer to general agents.

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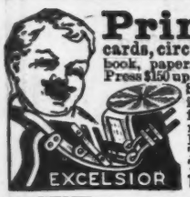


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cards, circulars, labels, tags, menus book, paper. Press $12. Larger $35. Job Press $150 up. CUTS EXPENSE IN HALF. SMALL OUTLAY. Pays for itself in short time. Will last for years. Easy to use, printed rules sent. Print for others, BIG PROFIT. Write factory TODAY for press catalog, TYPE, cards, paper, envelopes.

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Type-A-737 (300-700 meters) 6 inches square—non-directional $10

Type-A-7236 (175-1000 meters) 6 inches square—non-directional $12

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Type-BL-2520 (200-18,000 meters) with honeycomb coil mounting, 18 inches square—directional $25

Send for Bulletin U-102

V-DE-CO RADIO MFG. CO. Dept. O, Asbury Park, N. J.


## Is There a Polar Paradise?

(*Continued from page 31*)

It is no speculation of wild improbability to picture a polar paradise like some titan emerald in its alabaster setting. At Disco, Greenland, orchids warmed by natural hot springs blossom out of doors through the bitter sunless winter months!

Weighing carefully all the facts available, we may set the area of the new land at about 50,000 square miles, or roughly the size of the state of Pennsylvania. Its perimeter is bulwarked by a quake-distorted range of mountains buried in eternal ice and snow, and rearing 10,000 feet into the sky. Twisting fiords penetrate the ragged ice-gnarled coast.

Just inside the mountains hangs a veil of fog, the vapor of contrasting temperatures. For here we may imagine the aspect changes sharply. Heat from a nether world defies the cold. White of snow and ice shades swiftly to the green of verdant pastures, and gold of wooded uplands.

We come upon a level clearing on which are spread symmetrically half a hundred human habitations. Tall men magnificently built and clad in short and bright-hued loosely fitting blouses are moving leisurely about. Mingling with them are comely, fair-haired women in dainty smocks. Laughing children dash here and there among the shrubbery.

No savages are these descendants of the vanished colony. Indeed, we shall be mistaken if they are not far in advance of our own smug selves in culture, learning, deportment, and social refinement. They have harnessed natural energy to an amazing degree. They know the truths of other worlds. They have mastered the secrets of health.

### *May Revolutionize Commerce*

Yet we need not be swept away by too sanguine a view of what the ZR-1 may find. There are other features savoring more of cold, hard facts than of romance.

For instance, a polar air route cuts the distance to European and Asiatic capitals from 11,000 to 5000 miles. A vast volume of commerce and traffic will be deflected from America toward the Pole.

No matter what the land may be which lies close to the Pole, it will control the Polar Ocean strategically. Appreciation of this fact is evidenced by Amundsen's announcement that his next great effort to be first across will include three planes. And there are whispers that two other powers are grooming entries for the race.

Alaska then must come into her own. She will gather population and stand as an arctic service station to passing planes.

The ZR-1 may get away by early June. The weather then is calm; the daily temperature just above the freezing point. After her 6000-mile flight from Lakehurst to Point Barrow, from which she will eventually take off, there must be a period of final grooming; possibly a trial or two out over the icefields. And by the Fourth of July, 1924, we should know the answer to this most thrilling of all man's geographical conundrums:

*Does a polar paradise exist? And, if so, are the vanished Norsemen there?*

## The 10 Greatest Inventors

(*Continued from page 37*)

In the amazing development of uses for electricity, two names stand out among a score of modern miracle workers. They are Thomas A. Edison and Nikola Tesla—Edison, the creator; Tesla, the man of visions.

Nearly a thousand patents have been credited to Edison. But the single invention of the incandescent light would have entitled him to a place on the roll of the famous, for he has illuminated the world with a lamp that rivals sunshine in brilliancy and that is safe and convenient. This same invention paved the way for the vacuum bulb and long-distance radio.

Like Bessemer, Edison started on a career of research and discovery during boyhood. For rescuing the little son of a station agent from an oncoming train he was taught telegraphy by the grateful father. His first patent in 1868, when he had just passed his twenty-first birthday, was for a mechanical vote recorder.

Two years later, drifting into New York City without a penny, he invented the stock ticker that he sold for $40,000. With this fund he set up a little shop of his own at Newark, N. J., where he produced the quadruplex telegraph, saving millions of dollars in constructing telegraph lines.

But it was in his laboratory at Menlo Park, N. J., established in 1876, that Edison gave to the world his most useful discoveries. Here he produced the first phonograph, and here in 1879 he placed his first incandescent light in a circuit and burned it for 40 hours. Three years later, at the age of 35, he put into operation the world's first life-size experimental electric railroad. Edison has entered every place where men work and has lightened labor and made life more worth while.

### *Edison's Most Useful Discoveries*

Following Edison and carrying forward his work of harnessing electricity for the uses of mankind, comes his friend and admirer, Nikola Tesla.

In the discovery of alternating current power transmission, Tesla has carried to our very doors the energy of nature, split up into fractions of horsepower or grouped in thousands of horsepower, and distributed almost without loss. Tesla, standing at the turning point from the past to the future, has announced definitely that power soon will be transferred by wireless for commercial uses, lighting homes and driving airplanes; that wireless lights will be as common on the farms as ordinary electric lights now are in our cities.

He asserts that even now he is ready to transmit 1000 horsepower without wires with a loss of not more than five per cent in transmission, and he assures us that the day is not far off when we shall be able to go anywhere in the world—to the mountain top, to the Arctic, or to the desert—and set up a little wireless equipment that will give us heat to cook with and light to read by.

Born in what formerly was Austria-Hungary, Tesla from early youth was moved by the desire to harness the forces of nature for the service of mankind. It

(*Turn to page 138*)

You just bet it does!
SOMETHIN' GOOD EH?
TA TA TOOTALOO
FINE!
TAFA THERE SCRRARR BRRR
WOT WAS THAT?
CAN'T HEAR IT
MM
TA TA TOOTOO LOO TA TA TOO
THERE—T'ALL RIGHT NOW!
SQUEEE WEEEE SCRARRKK
THERE'S SOMETHING WRONG WITH TH' LOUD SPEAKER
I'LL BE THE LOUD SPEAKER GET A TUNGAR
IT RECHARGES YOUR BATTERY OVER NIGHT WITH YOUR OWN ELECTRIC CURRENT

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With Tungar in the house you are prepared for perfect reception always, without having to move the battery an inch. You renew again and again with Tungar and your regular electric light current.

Tungar attaches wherever there is a lamp socket or a convenience outlet. Just turn it on and leave it, any time, day or night. Its cost of operation is low. There are no moving parts to get out of order.

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*Special arrangements for lessons if you have your own Hawaiian Guitar.*

FREE A Beautiful Hawaiian Guitar


## The 10 Greatest Inventors

(*Continued from page 137*)

was soon after he had come to America in 1888 that through a large electrical concern he was able to manufacture his induction motor and to introduce on a large scale his system of alternating-current transmission, which since has been adopted universally.

His single achievement in the long-distance transmission of power places him definitely among the greatest inventors the world has known.

In the last few months man's mastery of the air has been demonstrated dramatically by a non-stop airplane flight across the United States, by the successful inauguration of transcontinental air mail, by the trial flight of the dirigible ZR-1, and by the amazing speed records of more than four miles a minute.

These achievements are reasons enough for adding Wilbur Wright to the list of the immortals of invention. By his imagination, by sheer daring, and by patient and undiscouraged experiment, Wright has opened the limitless sky to our use.

The flying machine had its beginnings in a simple toy—a device of cork and bamboo driven by rubber bands—that was given to Wilbur and Orville Wright by their father. They called it a bat. Failing to build a bat that would fly, they turned their attention to kites. The flying machine was the ultimate result.

While the brothers worked jointly, it is to Wilbur, the elder of the two, that we must give chief credit for the airplane. Because of his work, today such wonders as wireless control of pilotless airplanes are in sight.

### *Other Names Worthy of Honor*

It would be unjust to be silent concerning James Watt and the steam engine, or Marconi and wireless telegraphy, even though I do not include them in the list of the 10 greatest. Marconi hardly can be called an originator, since he adapted and applied the discoveries of the great Hertz, and since Preece, an Englishman, demonstrated a low-frequency system of wireless communication before him. Likewise, Gutenberg, the accredited father of printing, was foreshadowed in China centuries before. Fulton, Franklin, Westinghouse, Mergenthaler, De Forest, Stevens and the screw propellor; Hyatt, the discoverer of celluloid; Otto, the developer of the gas engine; Lake and Holland, creators of the modern submarine; Allen A. Canton, who has succeeded in deriving power from disintegrating atoms into electrons—none will deny the right of these to a place among the immortals. Yet, although they cannot be called imitators, they are not strictly originators. The inventions for which they are famous do not possess the epoch-making, widespread utility that marked the work of the 10 whom I have called the greatest.

With all these achievements we have only scratched the surface. Far greater inventions than the imagination can picture are on the horizon. For every new discovery, for every problem that is solved, a host of others await to be grasped by the inventive mind of man.

## Here Are Correct Answers to Questions on Page 46

**1.** Scientists believe that the tiny one-celled animalcules that live in ponds and ditch waters are plant-animal creatures that lived on earth before the animal and plant stem of evolution became divided.

**2.** The wireless waves are ether waves. They pass through water, earth, and all other kinds of matter in much the same way as they do through air. Wireless signals will pass down through water and can be picked up by apparatus inside the submarine just as if it were on the surface.

**3.** Soap contains a material that has the ability to stick very tightly to things. It creeps over their surfaces as a film of oil will creep over the surface of water. When you wash your hands, a very thin film of this material creeps all over your hands next to the skin. It even creeps in underneath any particles of dirt that happen to be sticking to your skin. It pushes these loose and the water washes them away.

**4.** The earth is shrinking slowly and this puts a good deal of strain on the surface rocks, especially in parts of the earth where the rocks are being forced up into the mountain wrinkles. Sometimes a few layers of the rock break under this strain and the rocks on one side of the break slip up or down or sidewise. The shock of this slip makes an earthquake.

**5.** No. It used to be believed that certain foods, especially fish and other foods containing phosphorus, were especially valuable for the gray matter of the brain. This is not believed any more. Brain cells apparently use the same kinds of food materials as all other living cells do. The best way to feed your brain well is to keep your body in good health.

**6.** Because of the currents in the ocean. Off the coast of Maine there is a cold current coming from the polar regions and flowing southward. It cools the air and makes the climate colder. Off the coast of France there is a warm current—the Gulf Stream. This gives a warmer climate.

**7.** Because the bird is touching only one wire. No electric circuit is completed.

**8.** No. If anything, they are more healthy. Prehistoric skeletons, as well as the mummies of ancient Egyptians, show they suffered from many of our diseases.

**9.** We are not sure, but it is probable that they migrated from Asia across the Behring Straits thousands of years ago. The easternmost point of Asia was probably connected then with Alaska by a land bridge that since has been submerged.

**10.** Food keeps on cooking as long as it is hot. The fireless cooker merely keeps it hot by preventing the loss of heat.

**11.** Many of the little nerve fibers in the brain that connect one brain cell with another get disconnected temporarily so that the messages between the cells cannot move about as freely as when we are awake. Some stop altogether. Others continue to move in a rather uncertain way, and this is what causes dreams.

**12.** There is no exact limit. It depends on the way the current passes through the body, on how long it lasts, on the general health, and so on. Ordinarily there is no danger from the usual house light circuits of 100 to 120 volts.


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## Evolution—A Universal Law

(*Continued from page 57*)

Science itself, being merely a tissue of known facts and accepted ideas, is subject to evolution. In primitive medicine, for example, it was customary to cut a hole into the skull in order to relieve headache. The idea, one imagines, was to let out some spirit or other evil creature who was believed to be producing the pain.

These ideas have evolved. We think differently nowadays about the cause of headache and we treat it, we feel sure, more successfully. Yet it is probable that the physicians of a few thousand years from now will look back on the medical theories and practices of 1923 with the same curious pity that we feel for the savage surgeons who cut into living skulls to let the demons out.

But the evolution of ideas and of customs, like that of human inventions, belongs really to the evolution of life. The body of man has evolved and his mind with it. To prove that evolution is a *universal* law we must produce evidence more fundamental than this. We must show that evolution applies to non-living matter as well as to living matter. Can this be done?

### *Evolution Applies to the Stars*

It can. One of the greatest achievements of modern science is that it has been able to prove within the past 20 years that evolution applies not only to life and to all products of life, but also to things as lifeless and as fundamental as the stars and the chemical elements.

If you take a telescope and go off adventuring with the astronomers into the depths of space, you will find that all the stars you can see are great suns like our own sun, many of them, in fact, much larger and hotter and mightier even than it is. All these star-suns belong, the astronomers find, to a single series, like the children of one family.

But the family of stars has one great difference from a family of children. The youngest stars are not the smallest ones, but the largest. The baby stars, born only a few billion years ago, are tremendously big. The old, old stars, millions and millions of years old, are small and shrunken and nearly dead.

What happens to the family of stars, the astronomers believe, is about like this: The first stage of a star, so far as we now know, is probably what is called a dark nebula. This is merely a vast cloud of very thin gas or dust spread about in a certain part of space. It sends out no light, so it looks dark. Gradually this cloud draws itself together into a more or less globe-shaped mass. As it does so, it becomes hot. It begins to shine. It enters the first visible stage of a star, a baby star in years, but a giant star in size.

One of the stars that is in this stage is the great red star called Betelgeuse that forms the shoulder of the hunter in the constellation of Orion. The size of this star was measured recently by the astronomers at the Mount Wilson Observatory, and it was found to be so vast that if it took the place of our sun, the entire orbit

(*Turn to page 141*)


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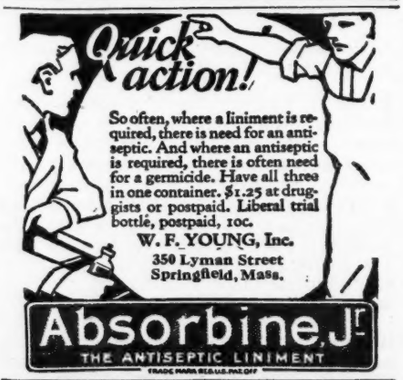


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## Evolution—A Universal Law

(*Continued from page 140*)

of the earth would lie inside it. Yet the matter of the star is very thin. It is a bubble of highly rarefied gas rather than a solid ball like the earth, or a globe of dense gas, almost liquid-like, such as we believe our sun to be.

What will happen to this young giant star as it grows older we can foresee, we believe, from the present condition of other stars. It will grow smaller and denser and at the same time hotter. After a while it will be a brilliant white star like the dog-star Sirius. Though it will continue to shrink, it will stop growing hot. Instead, it will cool off a little and its light will become more and more yellow. Presently it will resemble our sun, which is a star past the first vigor of youth and well along in middle age. Finally, as it cools off more and more, Betelgeuse will become still smaller, more and more reddish in color, less and less brilliant, more and more dense. In the end it will be altogether dark and probably solid.

### *Every Star Is Changing*

Every one of the thousands of stars that you see in the sky and each of the millions more that the astronomers have counted on their telescopic photographs is believed to represent a definite stage in this development from a dark gas cloud.

There are many details of this evolution that we still do not know. But of the fact that stars change there can be no question at all.

And with the chemical elements the proof is just as sure. A distinguished and sincere opponent of the theory of human evolution, Mr. William Jennings Bryan, has argued that if evolution be true of life, it ought to be true of everything, and that since (as he believes) it is not true of the chemical elements it cannot be considered true of life.

It is unnecessary to pause over the weak logic of this argument—the obvious possibility that evolution might be true of life and still not be applicable to everything. The evolutionist need not quibble. He can accept the argument on Mr. Bryan's own ground. If the theory of evolution is to stand or fall, as Mr. Bryan argues that it must, on the question of its applicability to the chemical elements, it will stand and Mr. Bryan should accept it. For the chemical elements *do* evolve and science has proved that they do.

The outstanding example of this chemical evolution is the element radium. The peculiar properties of this element—its continual emission of heat, the rays from it that affect a photographic plate, its ability to make the air about it a conductor of electricity, its curative properties in disease—all are due to the fact that the atoms of radium are in evolution.

Radium belongs, in fact, to a series of no less than 27 chemical elements that make up a known evolutionary series. The first one, the original parent element (so far as we now know) of the entire series, is uranium. Uranium changes after a while into another element called Uranium X, this into a third and so on for four changes. The fifth element is radium.

(*Continued on page 142*)


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The smart man will QUIT his job and learn a SURE TRADE. He will BUILD A BUSINESS OF HIS OWN. He will be independent and not at the mercy of strikes, depressions, and circumstances beyond his control.

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Roy A. Atkinson sent me this letter from Everett, Mo. "Worked on a farm," says Roy. "At nineteen had only $14.00. Got father to send me to the Sweeney School. Three days after I came home I fixed a neighbor's Ford car. That was my start. Today this garage is worth $4,785.00. My business takes three men to handle. I never worked in any other garage. I used my Sweeney training. If you want to get that start, do as I did and go to the Sweeney School."

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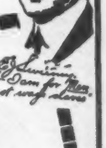

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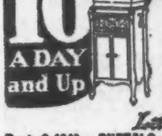

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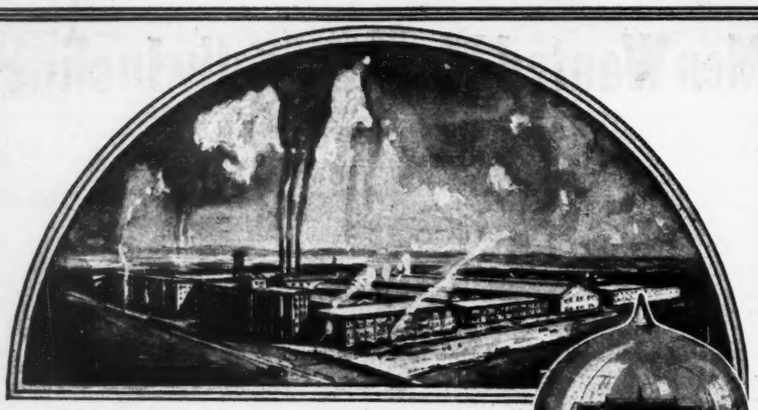

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## Evolution—A Universal Law

*(Continued from page 141)*

Then when radium changes, it produces a gaseous element called niton. This, too, evolves and changes into another element, a solid one this time, and so on until we reach an element which, if it changes at all, does so so slowly that we have not yet proved the change. This final element is lead.

No one believes, however, that lead is really final or unchanging. It merely changes so slowly that we have been unable, as yet, to detect the change.

We already have, indeed, some evidence that it does change. Not only lead but all other chemical elements have been found to possess in a very slight degree the same properties that make radium so remarkable. Radium produces much heat, but all kinds of matter produce a little heat. Radium gives out powerful rays, but all kinds of matter give out feeble rays of the same kind. It is probable, therefore, that all kinds of matter are undergoing evolution, though an evolution much slower than the change of radium.

### *Benjamin Franklin's Insect Story*

In an often quoted letter of Benjamin Franklin he speaks of those insects that live only for an hour or two in the summer and he imagines one of these to be describing to its companions the appearance of the world. The flower on which all of them lived was, quite evidently, eternal. Through the length of a long life, urged the oldest of the insects, the flower had not been observed to change. There were, moreover, ancient traditions that through many generations of previous insects there had been no change. How could such a thing as change be thought of in this pleasant perfumed plain?

Now we, who feel sometimes that we live so long and so importantly, have but little longer tenure of this pleasant earth of ours than had the tiny insect of his flower. Things that seem to us unchanging may be no more so, in reality, than is a flower, if only we grant time enough for them to change. Evolution is not a rapid process as men count time. It has required long and able investigation, the accumulation and study of innumerable facts, in order to discern it at all.

But this is not because evolution is concealed. It is because man lives for such a little while. Even the whole billion years of earth history into which we have crowded the origin and evolution of life is but a moment in comparison with the vastness of time.

THE END

### FOR FURTHER READING

ON THE evolution of the chemical elements see "Within the Atom," by John Mills, (D. van Nostrand Company, New York, 1922). The conclusion that all kinds of matter are slightly radioactive rests, in the main, upon experiments by Prof. R. A. Millikan announced in several scientific lectures but not yet published in full. I know of no comprehensive and non-technical book in English on the evolution of the stars. An excellent brief account is "The New Heavens," by Dr. George Ellery Hale, probably the most distinguished living astronomer. It is published by Charles Scribner's Sons, New York, 1922. A good short article on stellar evolution, by Isabel M. Lewis, was published in the *Scientific American* for July, 1923.

# The SIXTH SENSE OF INDUSTRY

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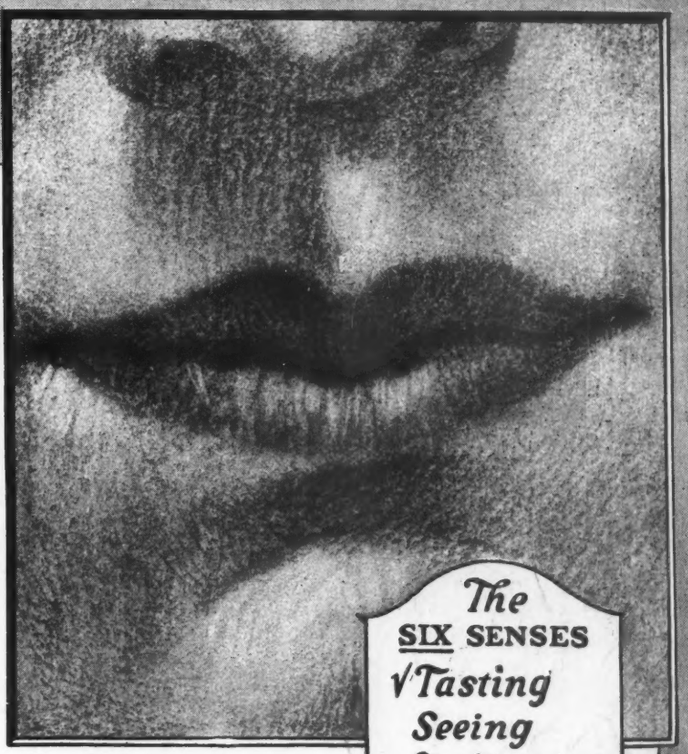

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